THE CREATIVE MINDSET IN DESIGN EDUCATION

A Dissertation

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DEDICATION

This dissertation is dedicated to my family, who supported me with love, understanding, and encouragement.

ABSTRACT

Creativity is an important problem-solving tool in the design context. People who are in design education treat creativity as an important component of their self-identity. Thus, it is imperative to develop and be mindful of creativity in design education. Most traditional design fields focus on creative outcomes that impact revenue, trends, and popularity. However, this current research shows that it is even more important to focus on people's state of mind (mindsets) and attitude in building their creative ability. Depending on people's attitudes toward their projects, some design solutions are more creative than others.

This research originated from two different types of attitudes and their subsequent outcomes involving students' mindsets in regard to the decision to be creative in an educational context. The decision to be creative is related to people's beliefs regarding their psychological traits and abilities, which plays an important role in influencing their own motivation and behavior (Dweck, 1999). According to Dweck's conceptualization, people hold different beliefs that represent their state of mind and explain their subsequent behavior. Some people perceive their abilities as fixed (fixed mindset: unable to change), while others believe that their abilities are malleable (growth mindset: able to change) (Dweck & Leggett, 1988). This research takes the perspective that the creative mindset is related to a growth mindset toward creativity.

The primary research objective of this study is to identify the presence of design students' creative mindset and how it is manifested in their work. This research also seeks to discover how the creative mindset operates and develops with respect to students' creative performance by incorporating the concept of the fixed/growth mindset toward creativity. In order to address these purposes, grounded theory was used with a qualitative triangulation. For a good sample selection, the growth mindset concept was applied to define high creative growth mindset students.

Throughout semester-long observations and interviews with these high growth mindset students selected from the existing implicit belief survey, the qualitative data established the fact that: 1) The creative mindset involves students' attitude toward design projects and is manifested as a positive attitude, such as having an open mind and demonstrating readiness at the beginning of their design process; 2) A positive attitude from students' creative mindset is closely related to learning goals, which is one of the main concepts of the growth mindset; 3) The creative mindset greatly affects the outcome of the design, and more specifically improves one's design ability, which contributes to student success from a long-term perspective; and 4) The creative mindset can be developed/enhanced through learning. The major findings of this study provide a number of important implications for improving pedagogical strategy, utilizing the concept of the growth mindset within a design education context. Moreover, this study provides directions for future research regarding the creative mindset in design education and suggestions for expanding this study to contribute to other disciplines.

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1. INTRODUCTION

Background: Design and Creativity

"…Design as a problem-solving activity can never, by definition, yield the one right answer: it will always produce an infinite number of answers…" (Papanek, 1971, p. 5). This quotation aptly illustrates how design has been adopted as a creative tool for solving problems. Given that our society is becoming more complex, and people are undeniably facing a wider array of problems, design processes are considered to be an important tool for tackling complex social and cultural problems. Designers use design thinking, which provides us with a new way of tackling problems and encourages us to adopt divergent approaches and new solutions (Brown, 2009).

Currently, design is perceived as a crucial means of fostering creativity and innovation when employed as a problem-solving tool, insomuch as the solutions should not be banal or useless; rather, they should be novel and useful. Thus, design is a field that inherently involves a *creative* problem-solving activity and necessitates making decisions to fulfill certain objectives. From the definitions and conceptions of design, it is important to understand how creativity operates in the design process. Designers' ideas develop as their problem-solving progresses. Therefore, each designer constructs his or her own representation of the design problem, dealing with a problem that becomes specific to him or her (Simon, 1995). In practice, different designers, supposedly solving the same design problem, reach different solutions (Bonnardel & Marmeche, 2005). In this process, some design solutions are more creative, while others are considered as less creative.

Design educators often see a similar process in the area of design education.

Although students may have the same design project, they approach it with different design solutions. These various design solutions produce different processes and outcomes: some designs are more innovative, while others are less so. There are many reasons why students perform differently in their creative design processes. However, through my own experience and observation, there is a common reason – their attitudes – that explains how they approach design projects. However, their thinking habits precede their attitude formation.

With respect to my own thinking habits, every single time a new project proposal was put in front of me, I would ask myself, *how am I going to come up with something new and innovative, and something exciting that challenges what is already out there?* In short, I asked myself how I was going to get excited about this new project. This is my usual mindset before starting a new design project. I have been involved in the educational environment for a long time as a design student, and later, as an instructor for design courses. I always look for a better creative design process (and product) from my students' design work.

In this context, I often see that some students are excited about their new design project, while other students tend to exhibit helplessness toward the new project: they differ in both their design processes and grades. The students who are excited about their new design project usually exhibit curiosity about the new assignment and are willing to design something new and innovative. Other students who perceive the new project as a bothersome, difficult chore usually see the new assignment as challenging, and they try to find easy ways to finish it. In essence, they display different attitudes when they are assigned a new design project.

This research originated from my interest regarding these two different attitudes and their subsequent outcomes. Why then do students act differently? Where do these attitudes come from? Do they adopt a certain mindset in terms of their new design project, like I do? If so, do these mindsets toward a design project affect their creativity? How do these mindsets influence students' creativity? The design area in higher education requires a high level of creativity for problem solving throughout the design process. Each design outcome tends to be unique and non-repetitive in its conception and development. People who are in design education treat creativity as an important component of their self-identity. If students' creativity can be affected by their mindsets, then investigating students' mindsets should be a first priority with respect to how they work differently. Thus, the research purpose is to investigate design students' mindset toward creativity in order to discover how the mindset influences their attitude and affects their performance.

Significance of the Study: Decision to be Creative, a Value of Design Education

Researching people's mindsets in terms of creativity is important because their mindsets play a critical role in the affection of their positive attitude. Creative performance usually starts with a positive attitude toward the creative process. A mindset is a particular way of thinking, tendency, or habit (Merriam-Webster Dictionary). People tend to start something from their own perspective and come up with ideas that are novel and useful in some way. This tendency to develop creative work originates mostly from the decisions that people make. People have the willingness to discover ambiguity, overcome obstacles, and find ways to do the necessary work before executing creative performance.

According to the investment theory of creativity, creativity is a decision similar to that of investment:

> …to be creative is to invest one's abilities and efforts in ideas that are novel and of high quality, and one must, like any good investor, first decide to generate new ideas, analyze these ideas and sell the ideas to others… People are not born creative or uncreative. Rather, they learn and develop a set of attitudes toward life that characterize those who are willing to go their own way. (Sternberg, 1988, p. 90)

Examples of such attitudes toward life include the willingness to: 1) redefine problems in novel ways; 2) take sensible risks; 3) sell ideas that others might not initially accept; 4) persevere in the face of obstacles; and 5) examine whether their own preconceptions are interfering with their creative process. These attitudes can be taught and instilled in students through education that motivates them to think about themselves (Sternberg & Lubart, 1991). For this reason, the current research will investigate design students' mindset for the "decision to be creative" when they have a design project in front of them; moreover, this research will investigate how the mindset operates with respect to students' creative performance.

Research involving students' mindsets in regard to the decision to be creative in an educational context is very important because one's attitude toward life reflects his or her willingness to follow his or her own way, which can be learned and developed. Generally, spontaneous attitudes appear in the process of creative work; furthermore, it has been found that people do their most creative work when their motivation is intrinsic rather than extrinsic. In this case, people care about what they are doing, and not just about what they will eventually end up with. In other words, they are performance oriented, not goal oriented (Amabile, 1983; Dweck, 1999).

From the perspective of educators, motivation is often viewed as a necessity for improving problem-solving abilities and generating creativity (Smith, 2008). Research regarding the relationship between students' learning strategies and motivational processes shows that a positive attitude toward a class motivates students to become engaged in their own learning. Furthermore, these motivational processes affect students' use of effective learning strategies and their subsequent performance in the classroom (Ames & Archer, 1988). These motivational processes explain how behavior is energized, directed, sustained, and impeded. A positive attitude usually energizes and sustains behavior that originates from within students, out of their interest and willingness to engage in an activity.

I believe that students' positive attitudes, such as willingness and curiosity, can be explained by intrinsic motivation. For example, curiosity is defined as "a desire to know, to see, or to experience something that motivates exploratory behavior directed towards the acquisition of new information" (Litman, 2005, p.793). The drive theory of curiosity refers to a person's cognitive and perceptual coherence, which can become disrupted by novel, complex, or ambiguous stimuli. By learning and gathering new information about related stimuli, it is possible to restore cognitive and perceptual coherence (Berlyne, 1950, 1955, cited by Litman, 2005). Put differently, curiosity toward stimuli facilitates one's willingness to *decide to act*.

This conception of intrinsic motivation can be applied to the creativity domain in design education. Indeed, intrinsic motivation can explain what a student's driving force is in being creative, and how he or she uses it for his or her design in order to be more creative.

According to Amabile (1983), intrinsic motivation arises from the individual's perceived value of engaging in the work itself. People seldom work creatively without really enjoying it versus obtaining possible rewards. Intrinsic motivation makes people become interested in something that they want to know more about; consequently, it makes them more likely to act upon their thoughts. A creative process starts with finding and formulating a problem (Sawyer, 2012). In other words, people should be willing to solve problems and should be curious about such problem, as well as the solutions. By using these overarching ideas of investment theory and intrinsic motivation, I define the creative mindset as *the decision to be creative*.

This study is also important because research concerning the creative mindset within design education is very sparse. As a result, this research can contribute new knowledge to the body of design education literature. In the area of educational research, creativity has a long history, starting from the second half of the twentieth century. Since then, creativity research findings have had a significant impact on educational objectives, teaching strategies, administrative practices, and the physical school environment (Torrance, 1983). In particular, design educational research is focused on the creative design process, design methods, and creativity training in design education (Lindström, 2006; Cropley & Cropley, 2010; Wong & Siu, 2012; Mawson, 2003). Most of the research on creativity has focused on creative skills, processes, or creativity levels; however, this research focuses on *the decision to be creative* in a design education context.

Researcher's Perspective: Creative Mindset is Related to a Growth Mindset toward Creativity

The current research has the following perspective: the creative mindset is related to a growth mindset toward creativity. The concept of a growth mindset is based on the theory of implicit beliefs. Implicit belief theory is one of the most important concepts in educational psychology. This theory explains people's beliefs regarding their psychological traits and abilities, which plays an important role in influencing their own motivation and behavior (Dweck, 1999).

According to research regarding implicit beliefs, people hold different beliefs that represent their state of mind, and explain how and why they behave the way they do. Some people perceive their abilities as fixed (fixed mindset: unable to develop/change), while other people believe that their abilities are malleable (growth mindset: able to develop/change) (Dweck & Leggett, 1988). This conceptualization shows how people develop beliefs about themselves; additionally, it shows how fixed and growth mindsets create their psychological worlds, influencing their thoughts, feelings, and behaviors. These mindsets explain why some people are motivated to work harder, and why others fall into patterns of passivity and self-defeating behavior.

When people *decide* to do something, they believe that they can create, develop, change, and make a situation better. Thus, the creative mindset is related to a growth mindset toward creativity; in other words, the creative mindset can be learned and developed. While analyses of fixed and growth mindsets are rarely provided within the creative domain (O'Connor, Nemeth, & Akutsu, 2013, Karwowski, 2014; Hass, Katz-Buonincontro & Reiter-Palmon, 2016), a few studies regarding the fixed/growth mindset concept of creativity will be reviewed. This research will adopt specific methods to demonstrate the relationship between the concept of fixed/growth mindsets and the creative mindset.

Overview of the Research

The objective of this study is to 1) contribute to an understanding of how design students' varied attitudes toward creative design work affect their creativity by incorporating the experiences of growth mindset students and relating these experiences to their creative mindsets; 2) gain knowledge regarding the relationship between design students' creative mindsets and their attitudes that motivate them to engage in design work creatively; and 3) establish the notion that the concept of fixed and growth mindsets can be applied to the creative mindset, thereby allowing design students to develop their creativity.

This research has expanded existing concepts, theories and knowledge regarding creativity, mindsets, and attitude to the design education domain. Also, this study provides directions for future research regarding creativity in design education. This research does not directly aim to explore the external circumstances that may affect students' creativity or their performance extrinsically, e.g., students' cultural and/or educational backgrounds, nor prove or compare existing studies and theories. Instead, this study focuses on defining phenomenon design students' thinking habits and states of mind in influencing their acts of creative performance.

Organization of the Dissertation

The creative mindset in design education will be discussed as follows. First, in the literature review chapter, an overview of related literatures will be provided. Specifically, a review of the creativity theories that are related to fixed/growth mindsets and mindset research in the educational environment will be provided. The existing concept of mindsets, and how this concept has been applied to learning satisfaction in educational settings will also be reviewed. In addition, how the concept of mindsets has influenced different attributes of educational psychology, such as goal orientations, self-efficacy, and the theory of attitude and behavior will be reviewed.

Afterward, based on the knowledge of the literature review and personal/professional experiences, a theoretical framework will be proposed, and three main research questions will be discussed. In the method chapter, a detailed description of the research design process, methodology, sample selection, and data analysis/interpretation will be provided. In the chapter on the findings, the research results and findings will be reported. In the final discussion chapter, a general discussion, including implications related to the research questions, study limitations, and future study plans will be presented.

2. LITERATURE REVIEW

An Overview of the Literature Review

Since this research focuses on students' thinking habits and states of mind that influence their creative performance, the literature review mainly addresses the definitions and theories of creativity, the concept of thinking habits (mindsets), and subsequent behavior/action in an educational context. Prior studies have found that people's mindsets influence their attitudes, and such attitudes affect their success.

Researchers have examined how people's mindsets regarding their ability influence motivation and performance in educational contexts. These scholars began by looking at achievement from students who were or were not highly motivated when they conducted their research on mindsets involving intelligence. They found that the students who were highly motivated enjoyed challenges, while other students easily gave up on their work. Thus, a student's inborn ability could not predict whether he or she was motivated, while motivation could.

Researchers found that there were two different types of students who held varying beliefs about intelligence, which affected their academic achievement and performance. These two different beliefs concerning intelligence are known as the growth mindset and the fixed mindset, which are beliefs about whether intelligence is a malleable or fixed characteristic (Dweck, 2006). Mindset research has mainly focused on people's intelligence, motivation, and their academic performance (Dweck, 1986, 2007, 1999; Dweck & Leggett, 1988; Hong et al., 1999). However, it has not fully investigated mindsets with respect to creativity.

This literature review aims to 1) define a specific definition of creativity and briefly examine theories of creativity that fit with the target group of this study, that is, design students in higher education; 2) explore the concept of mindsets and the perspectives of human qualities and intelligence, while gathering examples to broaden our knowledge regarding the realm of creativity within educational contexts; 3) analyze a few existing studies of the fixed/growth mindset concept regarding creativity and its measurement; and 4) use and adopt the existing development of the fixed/growth mindset in creativity as a conceptual framework for this study.

Definitions of Creativity and Implicit Mindsets Involving Creativity

Research objective 1: Gain knowledge about the relationship between design students' creative mindset and their attitudes that motivate them to engage in design work creatively.

Since this research is investigated design students' creativity and their performance, this section defines a specific definition of creativity and briefly examine theories of creativity that fit with the target group of this study, that is, design students in higher education.

Given the long history of research concerning creativity, many definitions and interpretations regarding creativity have been developed. According to Kaufman and Sternberg (2007), most definitions of creative ideas involve three elements. First, creative ideas must represent something new or innovative. Second, creative ideas should be of high quality. Third, creative ideas must be appropriate (Kaufman & Sternberg, 2007). Martindale (1989) argued, "[Creativity] must be original, it must be useful, or appropriate for the situation, and it must be actually put to some use" (p. 211). Also, according to Stein (1953), the definition of creative work includes "a novel work that is accepted as tenable or useful or satisfying by a group in some point in time" (p. 311). Similarly, Lubart (1994) defined creativity as the human ability by which a person comes up with and produces something novel and useful.

As these definitions show, there are several common elements, such as novelty and usefulness within a social context or a group. These explicit definitions are more likely focused on creativity in terms of the discoveries of great scientists, the musical masterpieces of great composers, and the paintings of great artists (Sternberg & Lubart, 1991). Stein (1953) argued that when researchers refer to creativity, they tend to limit their study to the genius level of creativity, which can “cause us to overlook a necessary distinction between the creative product and the creative experience” (p. 311). The creative experience (or creative process) is a subjective (personal) form of expressive creativity. There is the danger of ignoring the theoretical considerations of creative potential if these subjective creative processes are overlooked, and if the focus is only on the objective evaluations of conspicuously creative products (Runco, 2004).

In studying creativity, theorists have distinguished between levels or degrees of creativity, with the most common distinction involving Big-C (eminent), pro-c (professional), little-c (everyday), and mini-c (process) (Kaufman & Sternberg, 2010; Beghetto & Kaufman, 2009). Big-C creativity refers to obvious examples of creative productions, such as Einstein’s theory of relativity, Beethoven’s Ninth Symphony, and Van Gogh’s paintings. In this case, one’s achievement brings about a significant effect within a domain.

Pro-c creativity is associated with the creative performance of professionals or people with high abilities who are experts in their domain. Thus, not all professional people can accomplish their creative achievements, but generally, it is their goal to support themselves by doing something that they love.

Little-c creativity focuses on the creative acts of non-professional creative outcomes in everyday life. Little-c is generally evaluated with appropriate feedback and is counted as a creative outcome that may be valuable to others.

Different from little-c, mini-c refers to the creativity process; there is an important relationship between creativity and learning. Mini-c is “the creativity inherent in the learning process and defines the novel and personally meaningful interpretation of experiences, actions, and events” (Beghetto & Kaufman, 2009, p.3). Mini-c creativity is an explanatory process of personal ability and knowledge within a socio-cultural context that often occurs in self-assessment or interpersonal evaluations.

These definitions and interpretations of creativity as Big-C and pro-c may not take into account non-professional people. Indeed, little-c and mini-c need to be considered in the study of laypeople, who need to use the creative process in everyday life, such as design students.

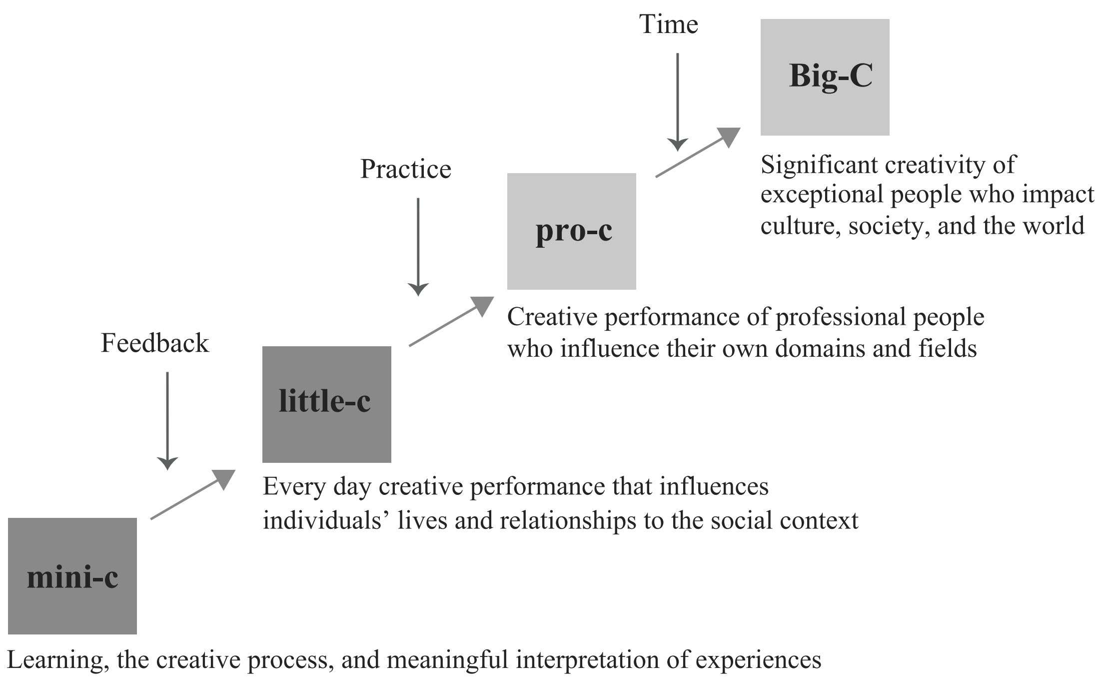

Figure 1. The Four-c Model of Creativity (Beghetto &Kaufman, 2009).

Another concept can be found in investment theory of creativity (Sternberg & Lubart, 1991). According to this theory, creativity can be found in our daily lives; additionally, it is executed from a decision to add value to initial ideas (the concept of buy low and sell high in the world of ideas), and creative performance is eventually evaluated as creative from its surroundings. There are four levels within the structure of investment theory: resources, abilities, projects, and evaluations. The six resources include knowledge, thinking style, intelligence, personality attributes, (intrinsic) motivation, and the environment. These six resources interact with one another and generate various domain-relevant creative abilities. Some abilities contribute to generating a portfolio of creative projects, which are evaluated to determine their creativity.

Within this structure, interactions among the six resources develop creativity. For example, an individual can have creative ability and the willingness (intrinsic motivation) to take risks, which can lead the individual to demonstrate the skill of creativity, such as divergent thinking. In addition, the environment can provide at least minimal support for creativity (Sternberg & Lubart, 1991). Creative individuals usually do not think or act the same way as others (they do not imitate others); rather, they maintain their own thinking and action in their own ways (generally new ways of thinking and acting). Thus, the biggest hindrance of creativity is that individuals limit themselves by not having their own thoughts, and by merely following others' opinions. This depends on individuals' development of their willingness to pursue their own way of thinking. It can be related to the belief that one's own abilities can be developed and/or changed.

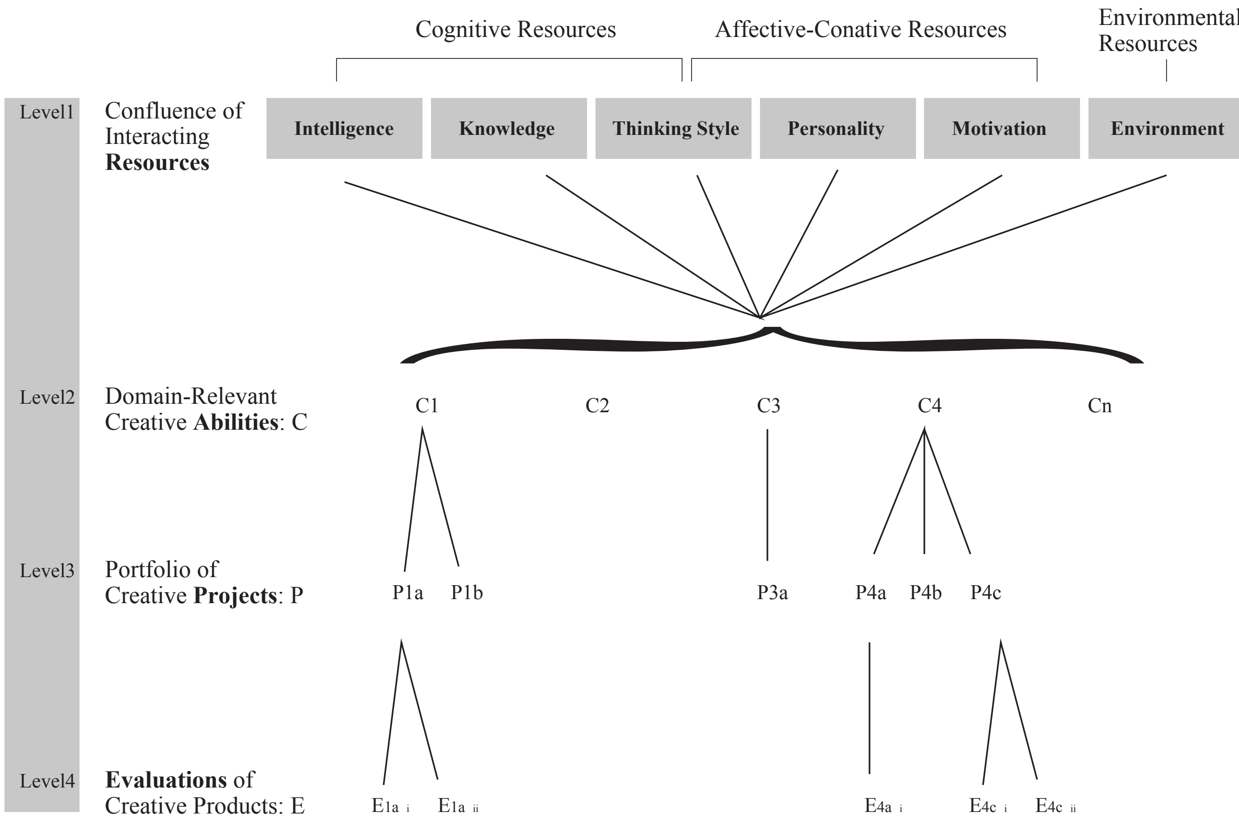

Figure 2. Investment Theory of Creativity (Sternberg & Lubart, 1991).

According to the theory of individual creative action (Ford, 1996), individuals' different actions (creative verses customary) are established by the slices of life that make up one's experiences. Creative actions are produced by interactions among sense-making, motivation, and knowledge/ability. These factors that influence creative actions are complex and have nonlinear processes; however, creative actions usually start from sense-making: an interaction of information seeking, interpretation of information, and acknowledgement of meaning.

The sense-making process typically evokes people's motivation and abilities to engage in creative action. In the sense-making process, individuals' goals/expectations play an important role in their motivation to tackle creative actions. These goals/expectations reflect individuals' beliefs regarding their abilities to initiate successful habits, such as creative action. In an educational context, students use their implicit beliefs involving creativity whenever they engage in something creative. Implicit beliefs regarding creativity imply self-perceptions of creativity, depending on how people think about their own creativity (Dweck, 1999) and the conceptions of the psychological states held by laypeople (Sternberg, 1985).

The main concept of many creativity theories is that all people have some level of creativity (Runco, 2004). Developmental theories claim that creativity develops over time from potential to achievement. These theories suggest that people basically have the potential for creativity; moreover, people articulate their creativity through a certain process and into more tangible forms of creative expression. Creativity is often influenced by interrelated factors, but many times people do not use all of their creative potential.

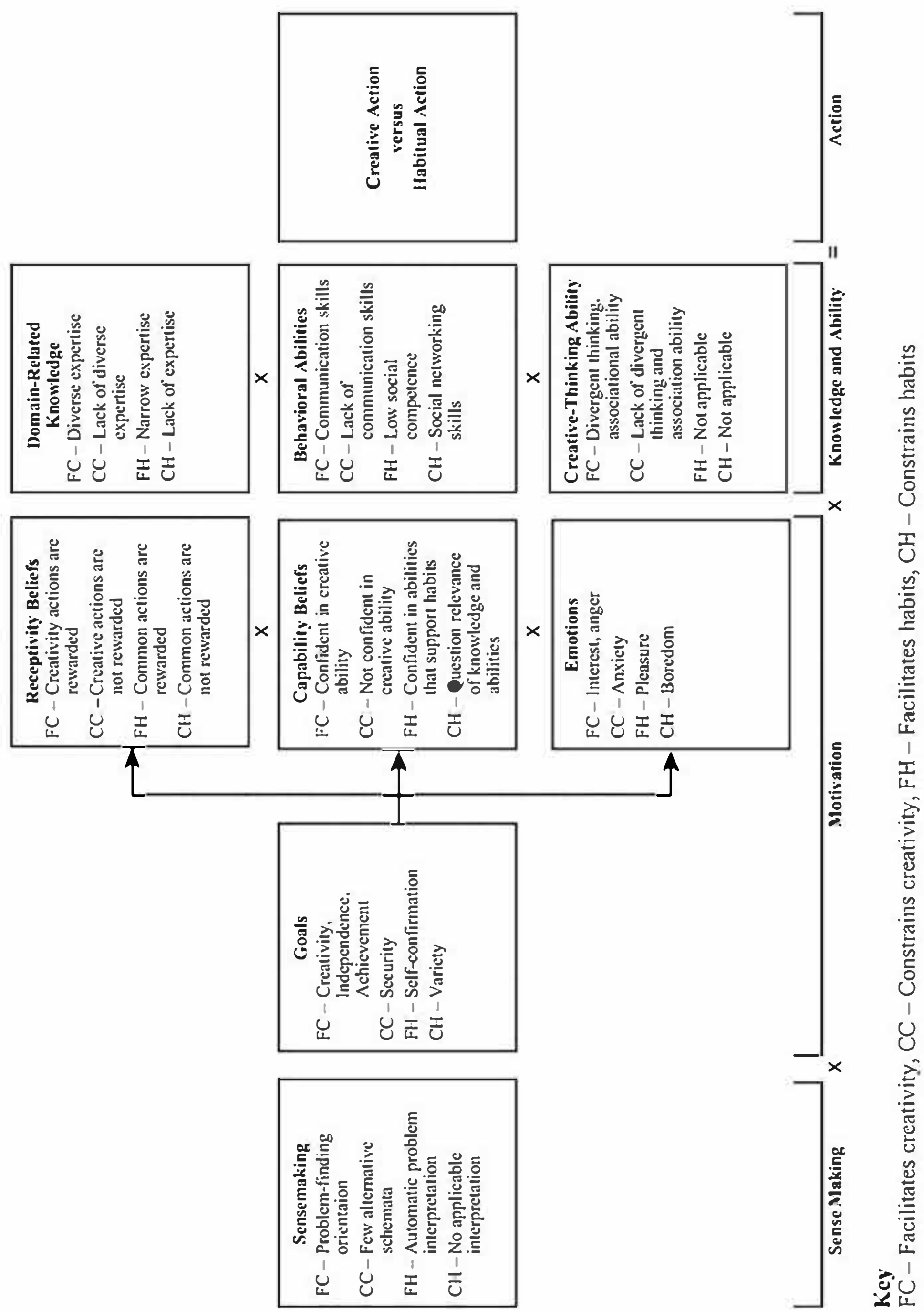

Figure 3. Theory of Creative Individual Action (Ford, 1966).

The Concept of Fixed and Growth Mindsets: Self-theories of Intelligence

Research objective 2: Establish the fact that the fixed and growth mindset concepts can be applied to the creative mindset so that design students can develop their creativity. Since current research discovered a relationship between the creative mindset and the fixed/growth mindset concepts, existing studies are explored to review the concept of mindsets and the perspectives of human qualities and intelligence, while gathering examples to broaden our knowledge regarding the realm of creativity within educational contexts.

Why, then, are there people who fully act on their creative ability versus those who rarely use it? There are many factors that may describe this phenomenon in terms of these individual differences, such as motivation and personality. However, they do not fully explain the mechanism of people's behavior in terms of how they work differently.
People hold different beliefs that represent their state of mind, which explains how and why they behave. Some beliefs describe a dynamic self, capable of growth. Other beliefs represent a static self with fixed personal qualities (Dweck, 1999). Dweck has examined how these unconscious beliefs about ability influence motivation and performance. Dweck (2006) generated the idea of mindsets and argued that people tend to endorse a growth or fixed mindset.

Researchers have tested these two different mindsets in an educational context to examine how these different mindsets influence students' academic achievement. With the fixed mindset, people tend to believe that their intelligence is a fixed characteristic. They also believe that their inborn talents, such as intelligence, lead to their success without effort; thus, they spend their time proving their abilities instead of developing them. With the growth mindset, however, people believe that their abilities can be developed through their own efforts (Dweck, 2006). A growth mindset helps create a love of learning and flexibility, both of which are essential for great performance and achievement.

The concept of mindsets is based on self-theories. According to Dweck's book *Self-theories*, these self-theories are ways of explaining people's motivation, personality traits, and their development using a theoretical approach (Dweck, 1999). Dweck explained self-theories as "the idea that people develop beliefs that organize their world and give meaning to their experiences. These beliefs may be called 'meaning systems,' and different people create different meaning systems…how people's beliefs about themselves (their self-theories) can create different psychological worlds, leading them to think, feel, and act differently in identical situations" (Dweck, 1999, p. xi). These self-theories refer to implicit theories of intelligence within the realm of social and developmental psychology.

There are two frameworks associated with self-theories, which are entity theory and incremental theory. If people endorse entity theory, they may think that their abilities are fixed; in other words, they cannot develop or change their abilities. Incremental theory is what Dweck refers to as the growth mindset. People who adopt incremental theory believe that human abilities can develop incrementally over time. Studies regarding self-theories have generally been conducted in the educational context to examine students' mindsets, performance, and their achievement. Students generally display two types of frameworks with respect to ability, which are the incremental and entity frameworks. Students who believe incremental theory regard intelligence as a changeable, malleable, and flexible quality. These students always search for opportunities to improve themselves so that they can derive pleasure from the process of learning. The result is not important to them; rather, it is important for them to learn from their experiences (Dweck, 1999; Dweck, 2006).

Students who believe entity theory, on the other hand, regard intelligence as a fixed and unchangeable trait. These individuals seek to signal to others that they are smart; as a consequence, they try to avoid looking unintelligent. Entity theorists are likely to exhibit helplessness and give up easily because they may feel that they cannot control their situations or circumstances. Researchers argue that students who adopt the entity theory of intelligence do not want to become involved in challenging tasks. Thus, if they perceive something as challenging, they may simply avoid it (Dweck, 1999).

Researchers found that entity students sometimes intentionally pick difficult tasks because they would then have an excuse for their failure. Moreover, they may not want to try their hardest on a task because they believe that success or failure is linked to a fixed amount of intelligence rather than effort. In other words, students who endorse entity theory may believe that failure indicates a lack of intelligence. Thus, those endorsing entity theory quickly begin to doubt their intelligence in the face of failure and lose faith in their ability to perform tasks.

In contrast, incremental students act differently when dealing with failure; they desire to solve problems and overcome challenges. When faced with challenges, they promptly begin to look for possible solutions to solve problems differently, and they dedicate themselves to overcoming these challenges. Incremental students believe that they actually develop their intelligence through effort and learning. They do not focus on the reasons for their failures. Moreover, they do not consider themselves as failing. Rather, they engage in some form of self-instruction or self-monitoring designed to aid their performance. When they encounter a difficult situation, they usually motivate themselves in order to try harder to overcome the difficult situation (Dweck, 1999).

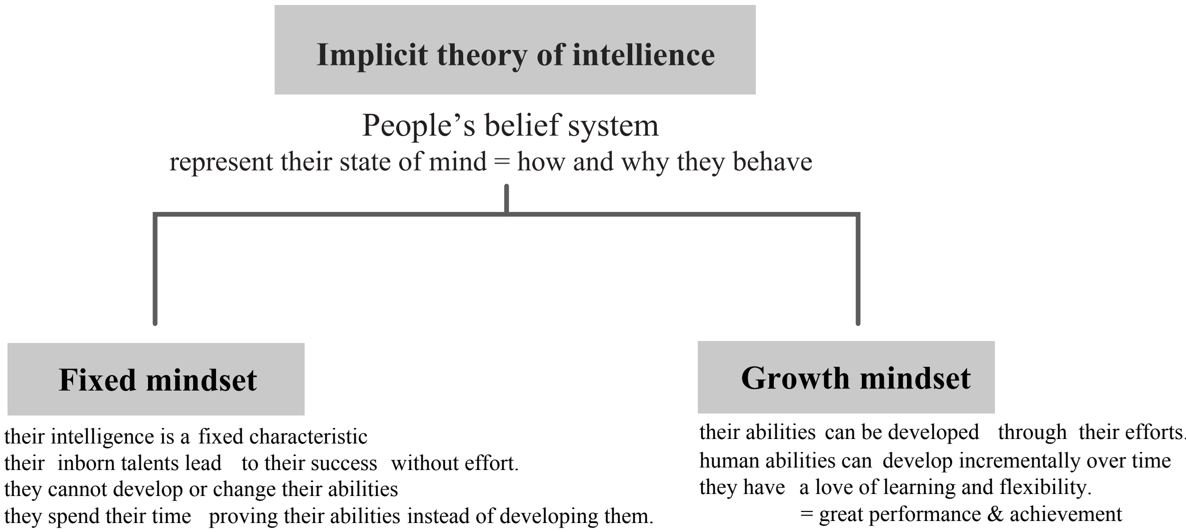

Figure 4. Implicit Theory of Intelligence (Dweck, 1999).

Defining mindsets

Dweck and her colleagues established an initial version of an instrument to measure participants' mindsets (fixed or growth), and later changed it to a three-item questionnaire that is widely used in current research involving mindsets. The previous version of the mindset evaluation includes questions such as the following: "You have a certain amount of intelligence, and you can't really do much to change it"; "Your intelligence is something about you that you can't change very much"; "No matter who you are, you can significantly change your intelligence level"; "To be honest, you can't really change how intelligent you are"; "You can always substantially change how intelligent you are"; "You can learn new things, but you can't really change your basic intelligence"; "No matter how much intelligence you have, you can always change it quite a bit"; "You can change even your basic intelligence level considerably"; "You have a certain amount of intelligence, and you can't really do much change it"; "Your talent in an area is something about you that you can't change very much"; "No matter who you are, you can significantly change your level of talent"; and "To be honest, you can't really change how much talent you have" (mindsetonline.com).

There is a six-point Likert scale, depending on the participants' degree of agreement. Most items are coded toward the fixed mindset, but some items address the growth mindset, which is reverse coded: "No matter how much intelligence you have, you can always change it quite a bit"; "You can change even your basic intelligence level considerably"; and "No matter who you are, you can significantly change your level of talent." Later, Dweck and her colleagues developed a three-item questionnaire to measure participants' mindsets about intelligence. The three-item series of questions are as follows: "You have a certain amount of intelligence and you really can't do much to change it"; "Your intelligence is something about you that you can't change very much"; and "You can learn new things, but you can't really change your basic intelligence." There is also a six-point Likert scale, ranging from "strongly agree" to "strongly disagree" (Hong et. al., 1999). Thus, if the result is a higher score, the participants are likely to believe that intelligence is a fixed trait.

Items from the later version of the mindset measurement, asking only for agreement or disagreement about fixed mindset ideas, are used because people tend to be more positive in responding to degrees of the growth mindset (incremental theorists), which are more socially desirable, even though they may not be incremental theorists in reality (Hong et al., 1999). In this study, researchers asked participants to explain their responses to the fixed mindset items. Most of the participants who disagreed with the fixed mindset items provided reasons that supported a growth mindset perspective (Hong et al., 1999). Therefore, in these studies, the researchers considered fixed and growth mindsets as independent factors.

Another study by Karwowski (2014) found that it is possible for an individual to hold both fixed and growth mindsets, depending on other external factors. However, researchers argue that people still tend to lean toward one or the other mindset. For instance, a person who is more likely to hold the growth mindset is less likely to hold the fixed mindset (Karwowski, 2014).

Researchers have also found that the mindset concept is related to motivation, and motivational factors influence students' academic performance and achievement (Dweck & Leggett, 1988; Roedel, Schraw, & Plake, 1994). According to Hennessey and Amabile (1987), the tendency for creativity thrives when people are motivated by their interest and enjoyment in the work itself. Motivation is one of the most important aspects of the growth mindset in creativity, as it elicits students' curiosity about things that they want to know more about; in addition, it helps them in their decision-making with respect to acting and obtaining knowledge about these things. Motivation is a personal drive to accomplish "the process of instigating and sustaining goal-directed behavior" (Schunk, 2008, p.453). In short, motivation is built around goals and goal-oriented behavior.

Researchers have found that there are different achievement goals. According to self-theories, there are different achievement situations with respect to entity and incremental people. For some people, challenges are tests of their intelligence, and when they encounter problems, they end up doing poorly on such “intelligence tests.” For others, the same situations indicate opportunities to learn new things. These two different attitudes come from different goals in achievement situations, which include performance and learning goals (Dweck & Elliott, 1983). One of the most influential (and most researched) motivational factors is goal orientation (Hass, Katz-Buonincontro & Reiter-Palmon, 2016).

The Power of Goals

According to self-theories, it does not matter who the individual people are. Rather, what is most important is the kind of goal a person has, and how that goal can produce entity and incremental mindsets. These two frameworks are associated with two very different goals. When people approach life with an entity mindset, their primary goal is performance based. A performance goal is based on measuring ability. If people have a performance goal, they want to look good and smart. They are very nervous that they will not look good to others. If intelligence is fixed and an individual’s performance is poor, then that person may believe that he/she does not have much intelligence, and that he/she cannot solve a difficult problem.

On the other hand, incremental people’s primary goal is to learn something new from any difficult situation. Learning goals, for them, involves mastering new things. According to their worldview, intelligence is not fixed; rather, it can be improved incrementally over time. Therefore, they are less concerned about looking smart in every single situation and performing well. When they experience challenges, they welcome them, whereas entity theorists avoid them (Dweck & Leggett, 1988; Dweck, 1999).

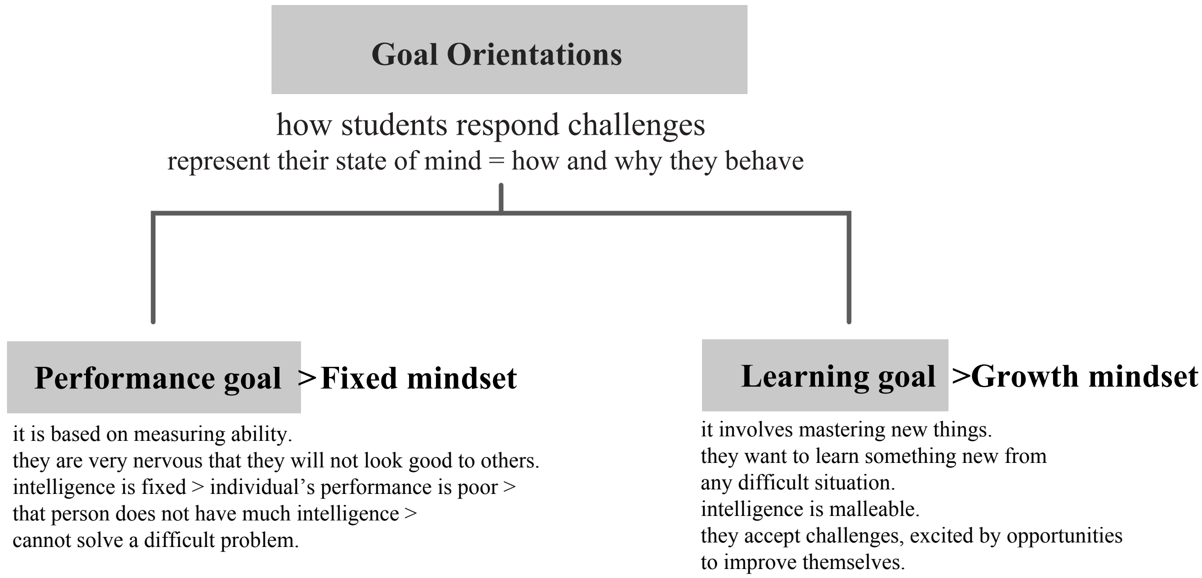

Figure 5. The Concept of Goal Orientations (Dweck & Leggett, 1988).

One of the interesting aspects in this research is that entity and incremental people are actually very similar when things go well. In a positive situation, it does not matter whether people endorse either one of these theories. However, once a situation becomes challenging for entity theorists, such as experiencing mistakes or failure, things change. Entity theorists feel distress when they experience failure and tend to exhibit a vulnerable, helpless response toward challenges and failure.

On the contrary, incremental people possess a mastery response toward failure and accept challenges, excited by opportunities to improve themselves. These two different behavior patterns (mastery-oriented and helpless) are created by different goal orientations (Dweck & Elliott, 1983). Goal orientation research demonstrates the power of goals and can be an important aspect in determining design students' creative mindsets. A design project often deals with challenges to solve a difficult problem creatively. Thus, identifying students' goal orientations helps us know how students respond to these challenges. Students may not worry about their creativity when they experience difficulty; instead, they focus on the challenges and maintain their problem-solving strategies. Other students, however, may blame their fixed creativity and may not try to solve a design problem. Mastery-oriented and helpless behavior patterns are identified as two distinct reactions to failure and challenges (Ames & Archer, 1984).

Goal orientation is also very important because it can explain the intrinsic motivation principle of creativity. Hennessey and Amabile (1987) proposed the "intrinsic motivation principle of creativity" (p. 6), which states that intrinsic motivation promotes creativity, whereas extrinsic motivation hinders it. Intrinsically motivated people engage in an activity because of their interest and curiosity in it. Curiosity encourages an internal desire or need to flourish in order to explore and learn new information. For these individuals, their primary goal is to master a new activity (learning goal).

On the other hand, extrinsically motivated people attempt to carry out an activity because there are external goals, such as rewards, evaluation, and praise. Their primary goal is to measure their ability (performance goal).

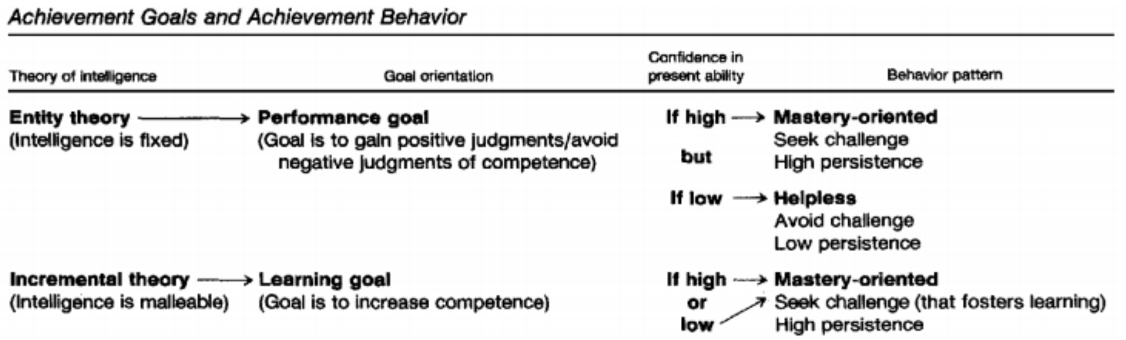

Figure 6. Relationship between Implicit Theory of Intelligence and Goal Orientations. Dweck (1986).

Defining Goal Orientations

Roedel, Schraw, and Plake (1994) developed the Goals Inventory in their research as a validation of goal orientation measurement in a school setting. The researchers compared students' goal orientations and reactions to tests, such as tension, worry, and general test anxiety. The inventory was designed to measure the learning goal and performance goal orientations described by Dweck and Leggett (1988). The inventory consists of 25 items, reflecting the mindsets and behaviors associated with learning and performance goal orientations.

The inventory items are divided into three subscales, such as L (Learning goal), P (Performance goal), and F (Filler items). Several examples of the items are as follows: (L) "I enjoy challenging school assignments"; (L) "I persevere, even when I am frustrated by the task"; (P) "It is important for me to get better grades than my classmates"; (L) "I try even harder after I fail at something"; (F) "Academic success is largely due to effort"; (F) "Sticking with a challenging task is rewarding"; (L) "I adapt well to challenging circumstances"; (L) "I work hard, even when I don't like a class"; (L) "I am very determined to reach my goals"; (P) "I like others to think I know a lot"; and (P) "It bothers me the whole day when I make a big mistake." The below table shows the full scale of the Goals Inventory (Roedel, Schraw, & Plake, 1994).

I enjoy challenging school assignments.	Learning goal
I persevere even when I am frustrated by a task.	Learning goal
I try even harder after I fail at something.	Learning goal
I adapt well to challenging circumstances.	Learning goal
I work hard even when I don't like a class.	Learning goal
I am very detemines to reach my goals.	Learning goal
Personal mastery of a sybject is important to me .	Learning goal
I woek very hart to improve myself.	Learning goal
I am naturally motivated to learn.	Learning goal
I preper challenging tasks even if I don't do as well at them.	Learning goal
I feel most satisfies when I work hard to achieve somehting.	Learning goal
I give up too easily when faced with a difficult task.	Learning goal
It is important for me to get beteer grades than my classmates.	Not clear
I like others to think I know a lot.	Performance goal
It bothers me the whole day when I make a big mistake.	Performance goal
I feek very angry when I do not fo as wll as others.	Performance goal
It is important to me to always do better tha others.	Performance goal
Academix success is largely due to effort.	Not clear
Sticking with a challenging task is rewarding.	Not clear
I am willing to cheat to get a good grade.	Not clear
Every student can learn to be a succeddful learner.	Not clear
Learning can be judged best by the grade one gets.	Not clear
My grades do not nedessarily reflect how much I learn.	Not clear
Miskages are a healthy part of learning.	Not clear
I would rather have people think I am lazy then stupid.	Not clear

Table1. Goals Inventory (Roedel, Schraw, & Plake, 1994). Note. L: Learning subscale; P: Performance subscale; F: Filler item.

Research using the Goals Inventory showed that the performance subscale was correlated positively with tension, worry, other test anxiety, and test-irrelevant thinking. Thus, performance-oriented individuals tended to focus on normatively high performance (test grades). By contrast, high learning scores were not associated with test anxiety, an outcome consistent with high concern for improvement, but low concern for normatively high performance (Roedel, Schraw, & Plake, 1994).

Several researchers have found that the two different goals predict various academic performance measurements, such as students' grades and test scores, their performance in school activities, and their motivation (Dweck, 1999). As a result, the Goals Inventory can be used to identify students who benefit from flexible behaviors in the classroom and can distinguish the types of mindsets and behaviors that contribute to high performance and high self-esteem.

Self-perception of Creativity

Self-perception is one of the theories of attitude formation in terms of understanding one's own mental image, in which people's attitudes are developed by observing their own behaviors. According to the theory of self-perception, there are two actions that can happen to individuals. The first action occurs when people come to know their own attitudes from their own behavior. The second action occurs when internal cues are weak, and individuals exhibit the same behavior as outside observers, building their own knowledge with the external cues of their own behavior in assuming their own beliefs (Bem, 1972).

For example, one student may observe another student drawing, without any external motivation, such as better grades. He or she may develop an appreciation of drawing. This makes the student understand that he or she is a genuine lover of drawing. This student uses his or her own behavior to assume his or her own beliefs and attitudes. Presumably, this process of developing self-knowledge will influence students' motivation and self-efficacy. Once the student knows that he or she genuinely likes to draw, drawing will be the student's habit, and later on, the student can be an expert in drawing, which will enhance his or her self-efficacy in drawing. Thus, knowing students' self-perceptions of creativity is important in understanding their attitudes toward creativity and creative performance.

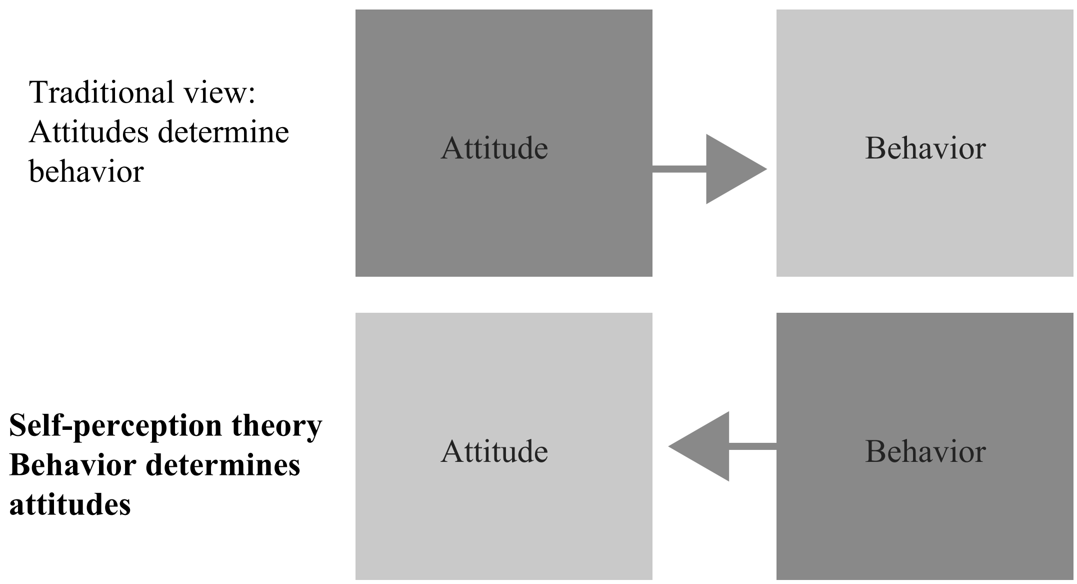

Figure 7. Self-perception Theory (Bem,1972).

In previous research regarding creative fixed and growth mindsets, a couple of measurements related to the self-perception of creativity were conducted, namely self-confidence/self-efficacy (Makel, 2008; Hass, Katz-Buonincontro & Reiter-Palmon, 2016; Puente-Diaz, 2016), and the self-concept (Karwowski, 2014). Based on the questionnaire items, self-confidence/self-efficacy and the self-concept can be subsets of creative self-perception, since all items ask only about the description of people's attitudes, but not the phenomenon of creative self-perception, which is already developed by observing their behavior.

Makel (2008) used a self-confidence measurement from Dweck and Leggett's model (1988). The original items regarding intelligence were as follows: "I usually think I'm intelligent" versus "I wonder if I'm intelligent"; "When I get new material, I'm usually sure I will be able to learn it" versus "When I get new material, I often think I may not be able to learn it"; and "I feel pretty confident about my intellectual ability" versus "I'm not very confident about my intellectual ability." The responses are coded from 1 (very true) to 3 (sort of true), and this rating is recorded on a six-point Likert scale from 1 (very true for the first choice) to 6 (very true for the second choice) (Hong et al., 1999).

Self-confidence in terms of creativity was collected using a three-item series of questions. These items consisted of two very different statements about participants' own creativity. The participants were asked to rate how much the selected statements were true for them. The responses were then coded from 1 (very true) to 3 (sort of true), and the ratings were recorded on a six-point Likert scale from 1 (very true for the first choice) to 6 (very true for the second choice). The three-item series of questions include the following: "I think I am creative" versus "I wonder if I am creative"; "I am good at coming up with new ideas" versus "I usually have a hard time when I need to come up with new ideas"; and "I always think I am able to do this new project successfully" versus "I wonder if I am able to do this new project successfully." These items consist of two revised statements regarding participants' self-descriptions of their own creativity (Hong et al., 1999; Makel, 2008).

In Makel’s (2008) study, a self-perception measure in creativity was collected via a three-item series of questions used in previous research by Hong et al. (1999). This test questionnaire follows (but varies slightly from) previous research by Dweck and her colleagues (Hong et. al., 1999). According to the results of previous research, participants with a fixed mindset consistently score at the lower (agree) end of the scale (the mean score is 3.0 or lower), whereas participants with a growth mindset score at the upper (disagree) end of the scale (the mean score is 4.0 or above) (Makel, 2008).

A similar concept of self-efficacy was measured in the study of creativity. Researchers have found that there is a positive relationship between creative self-efficacy and creative performance, along with the growth creative mindset (Karwowski, 2014); Hass, Katz-Buonincontro & Reiter-Palmon, 2016). Self-efficacy was measured by six items (adopted from Beghetto (2006)’s study: “I am good at coming up with new ideas”; “I have a lot of good ideas”; “I have a good imagination”; “I feel that I am good at coming up with novel ideas”; “I have confidence in my ability to solve problems carefully”; and “I have a knack for further developing the ideas of others.” Participants responded to each item with a five-point Likert scale (Hass, Katz-Buonincontro & Reiter-Palmon, 2016).

In studies from Karwowski (2014) and Hass et al. (2016), researchers also measured the relationship among self-efficacy, fixed and growth creative mindsets, and creative identity. One’s creative identity refers to a positive attitude and an appreciation of creativity, while self-efficacy is a part of one’s creative identity (Beghetto, 2006). Researchers found that one’s creative identity largely correlated with self-efficacy, and that these two concepts have a positive relationship with the creative growth mindset (Puente-Diaz, 2016).

Self-identity was measured by four items (used from Jaussi, Randel, & Dionne (2007)'s study): "In general my creativity is an important part of my self-image"; "My creativity is an important part of who I am"; "Overall, my creativity has little to do with my identity"; and "My ability to be creativity is an important part of who I am." Participants responded to each item with a five-point Likert scale (Hass, Katz-Buonincontro & Reiter-Palmon, 2016).

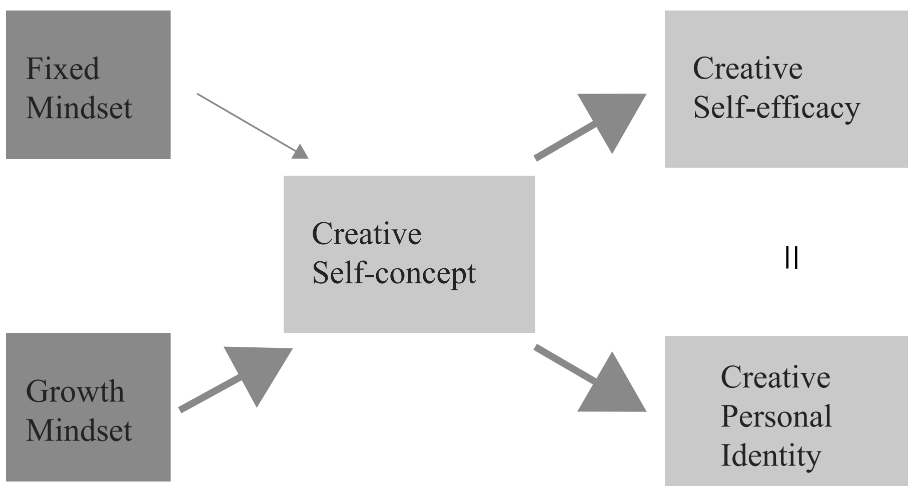

Figure 8. Relationship between Creative Self-concept (Creative Self-efficacy and Creative Personal Identity) and Growth Mindset. Creative identity largely correlates with self-efficacy. These two concepts have a positive relationship with a creative growth mindset (Karwowski, 2014).

Fixed and Growth Mindsets in Creativity

Different from the characteristics of intelligence, the myth that people have to be born creative (fixed mindset) is one of the most harmful beliefs if they want to develop their creativity (Plucker, Beghetto, & Dow, 2004). Despite the recognition of creativity as a fixed or malleable trait, however, little research exists involving the mindset concept by creativity researchers (O’Connor, Nemeth, & Akutsu, 2013; Karwowski, 2014; Hass, Katz-Buonincontro & Reiter-Palmon, 2016; Puente-Diaz, 2016).

There are several findings that malleable beliefs (growth mindset) regarding creativity are associated with the motivation to think creatively, the self-concept of creativity, creative problem solving, and perceived efforts and performance (O'Connor, Nemeth, & Akutsu, 2013; Karwowski, 2014; Hass, Katz-Buonincontro & Reiter-Palmon, 2016). People who believe that creativity can be developed (growth mindset) by effort rather than by inborn talent are more likely perceive themselves as being more creative (Karwowski, 2014). Empirical findings have shown that the growth mindset is positively related to creative self-efficacy, enjoyment, and perceived performance and effort exerted (Puente-Diaz, 2016). Indeed, people who believe that they are more creative than others are motivated to engage in creative thinking.

Since there exists little research involving the mindset concept and creativity, researchers have focused on exploring several measurement methods for fixed/growth mindsets in the creativity domain. Because of individual differences in the measurement methods with associated variables (creative fixed/growth mindsets, creative self-efficacy, creative identity, and creative performance), a more recent research aimed to “explore whether a measurement model for creative ability should include self-efficacy, identity, and mindsets as independent factors, or whether it is better to construct a more nuanced model (Hass, Katz-Buonincontro & Reiter-Palmon, 2016, p. 436)”. This research tested a comprehensive measurement consisting of items from previous studies, such as those from Dweck (1999), Beghetto (2006), Karwowski (2014), and Jaussi, et al. (2007), and items that are more elaborately worded and more specific to the creative process, such as those from Karwowski (2014).

Dweck and her colleagues' (1999) studies have shown that two different types of students with growth and fixed mindsets hold varying beliefs about intelligence, which affect their academic achievement and performance. Due to this finding in their studies regarding implicit beliefs of intelligence, researchers in the creativity domain have adopted and used Dweck's measurement tool (Makel, 2008; O'Conner, Nemeth, & Akutsu, 2013; Karwowski, 2014; Hass, Katz-Buonincontro & Reiter-Palmon, 2016).

Based on Dweck's (1999) evaluation tool, researchers in the creativity domain replaced the word "Intelligence" with "Creativity" at first, but then found that it did not function well in terms of measurement (Makel, 2008; Hass, Katz-Buonincontro & Reiter-Palmon, 2016). Inspired by previous research questionnaire items, Karwowski (2014) designed a "Creative Mindset Scale" to measure people's fixed/growth mindsets in terms of creativity (2014). The items used in the scale are more descriptively worded and are more specific to the creative process.

The "Creative Mindset Scale" includes a 10-item scale, such as the following: 1) "Everyone can create something great at some point if he or she is given appropriate conditions"; 2) "You either are creative or you are not-even trying very hard you cannot change much"; 3) "Anyone can develop his or her creative abilities up to a certain level"; 4) "You have to be born a creator-without innate talent you can only be a scribbler"; 5) " Practice makes perfect-perseverance and trying hard are the best ways to develop and expand one's capabilities"; 6) "Creativity can be developed, but one either is or is not a truly creative person"; 7) "Rome wasn't built in a day-each creativity requires effort and work, and these two are more important than talent”; 8) “Some people are creative, others aren’t-and no practice can change it”; 9) “It doesn’t matter what creativity level one reveals-you can always increase it”; and 10) “A truly creative talent is innate and constant throughout one’s entire life.” Answers were measured on a five-point Likert scale (1=definitely not, 5=definitely yes).

After Karwowski’s (2014) study was published, Hass, Katz-Buonincontro & Reiter-Palmon, 2016) proved that Karwowski’s mindset scale is more reliable than a scale that replaced the word “Intelligence” with “Creativity” from Dweck’s (1999) item. The main results of the study indicate that “creative self-perception (efficacy), fixed/growth mindsets are separate but interrelated constructs, and that fixed/growth mindsets are better measured using descriptions that pertain specifically to the creative process” (Hass, Katz-Buonincontro & Reiter-Palmon, 2016, p.443).

According to this study, using only items involving fixed/growth mindsets in creativity did not effectively measure students’ implicit creative competence. Thus, the study suggested that the best measurement model for implicit creative beliefs needs to include self-perceptions of creativity, more specifically, the self-efficacy of creativity. The study also suggested that fixed/growth mindsets are measured more accurately when an elaborate description and creative process-focused items are used (Hass, Katz-Buonincontro & Reiter-Palmon, 2016).

Dewck's Initial Version	You have a certain amount of intelligence, and you can't really do much to change it Your intelligence is something about you that you can't change very much No matter who you are, you can significantly change your intelligence level To be honest, you can't really change how intelligent you are You can always substantially change how intelligent you are You can learn new things, but you can't really change your basic intelligence No matter how much intelligence you have, you can always change it quite a bit You can change even your basic intelligence level considerably You have a certain amount of talent, and you can't really do much change it Your talent in an area is something about you that you can't change very much No matter who you are, you can significantly change your level of talent To be honest, you can't really change how much talent you have	**Fixed/Growth mindsets toward intelligence**
Dewck's Revised Version (Hong et. al., 1999)	You have a certain amount of intelligence and you really can't do much to change it Your intelligence is something about you that you can't change very much You can learn new things, but you can't really change your basic intelligence	**Fixed/Growth mindsets toward intelligence**
Makel (2008)	You have a certain amount of general ability and you really can't do much to change it You have a certain amount of creativity and you really can't do much to change it Your general ability is something about you that you can't change very much Your creativity is something about you that you can't change very much You can learn new things, but you can't really change your basic general ability You can learn new things, but you can't really change your basic creativity	**Fixed/Growth mindsets toward Creativity**
Karwowski (2014) Creative Mindset Scale	Everyone can create something great at some point if he or she is given appropriate conditions You either are creative or you are not-even trying very hard you cannot change much Anyone can develop his or her creative abilities up to a certain level You have to be born a creator-without innate talent you can only be a scribbler Practice makes perfect-perseverance and trying hard are the best ways to develop and expand one's capabilities Creativity can be developed, but one either is or is not a truly creative person Rome wasn't built in a day-each creativity requires effort and work, and these two are more important than talent Some people are creative, others aren't-and no practice can change it It doesn't matter what creativity level one reveals-you can always increase it A truly creative talent is innate and constant throughout one's entire life	**Fixed/Growth mindsets toward Creativity**

Table 2. Adopting Fixed/growth Mindset for the Creativity Domain.

Attributional Retraining

Research objective 3: Contribute to an understanding of how design students' varied attitudes toward creative design work affect their creativity by incorporating the experiences of growth mindset students and relating these experiences to their creative mindsets. In order to relate the concept of growth mindset to the creative mindset, attributional retraining concept is needed to be explained to understand importance of incorporating the growth mindset concept: students can develop and change their mindset.

Attributional retraining is referred to as motivation-enhancing treatment and is one of the most significant applications of fixed/growth mindsets. The reason why the mindset concept is applied to this creative mindset study is that attributional retraining can be a driving force for students without a creative mindset to change their thinking and goals, which can affect their creativity. Attributions are descriptions that students use to explain their perceptions of their outcomes. According to the main argument of the creativity literature, personal attributes facilitate or constrain individual creative performance.

Attributional retraining modifies one's cognitive attributions and is designed to enhance motivation and encourage achievement by changing how students think about their academic successes and failures (changing the attributions they assign to their outcomes); in doing so, their beliefs can work for, rather than against their effort toward academic success (Andrews & Debus, 1978). Attributional retraining is used as a tool to improve students' psychological profiles and preparation for their learning.

One of the most important and interesting facts about mindsets is that they can be changed and developed. Attributional retraining explains how students change and develop their mindsets. Dealing with failure is one of the key ways of showing how students differ. Dweck and her colleagues (1999) took a group of extremely helpless students who responded poorly to failure and who gave up easily on challenges. They did attributional retraining in order for them to deal with failure more constructively.

Most entity theorists think that they fail because of their ability. As a result, researchers trained them to see that they failed because they did not put enough effort into their tasks, which is more in line with incremental theorists. After attributional retraining, the researchers gave them a failure opportunity. The result was that the entity mindset participants realized that effort could help them overcome their obstacles. Motivation-enhancing treatment retrains students to think about their achievement as something they can actively influence. Therefore, attributional retraining can be a driving force for students with fixed mindsets to change their thinking and goals, which can affect their achievement. Based on the concept of attributional retaining, creativity is one of the basic qualities of human beings that can be improved through effort (putting effort into acquiring a growth mindset regarding one's creativity), although one of the most common creativity myths is the belief that creativity is a fixed trait that cannot be changed (Sawyer, 2006).

Summary of the Literature Review and Proposed Conceptual Framework

In this literature review, specific definitions of creativity regarding mini-c (which highlights the personal and developmental aspect of creativity) and little-c (which is a growth level from mini-c, focusing on laypeople's awareness and acceptance of everyday conceptions of creativity) are addressed to clarify the level of creativity examined in this study. According to the implicit theory of creativity, these levels of creativity are acted upon, depending on individuals' implicit beliefs regarding their own creativity, and are initiated from people's willingness/motivation. Thus, previous studies of implicit theory were explored in this literature review. Researchers have investigated the notion that mindsets are beliefs about an individual's basic qualities, such as intelligence and personality. In an educational context, students think and perform differently, depending on what they believe in regard to their abilities. Mindsets influence students' subsequent behavior and their academic success.

Research instruments from previous studies were adopted to design a research method for this study in order to generate knowledge about the relationships among the self-perception of creativity, goal orientations, and the growth mindset of design students in the creativity domain. The literature shows that the self-perception of creativity, particularly the self-esteem of creativity, could affect creative mindsets, in that an appreciation of creativity and a positive attitude toward creativity are important elements of a growth mindset (Dweck, 1999). Moreover, positive self-perception creativity could indicate students' confidence in their creativity. Dweck and Leggett (1988) predicted in their research that students' confidence levels would interact with their goal orientations. These students' confidence levels could also then affect their creative growth mindsets.

Based on all of these theories and conceptions about implicit theory and creativity, this study investigates the scope of the findings of Dweck and her colleagues (1999) regarding the fixed and growth mindsets in the creativity domain, with the goal of relating these findings to design students' creative mindset and finding ways to increase their positive attitude toward the creative design process. Even though Dweck's (1999) concept of mindsets has not been particularly developed, in the sense that growth and fixed mindsets involve beliefs about creativity, this study explores the notion that the concept of mindsets relates to creativity in design education, which can correspond to design students' creative mindset, or the *choice to be creative*.

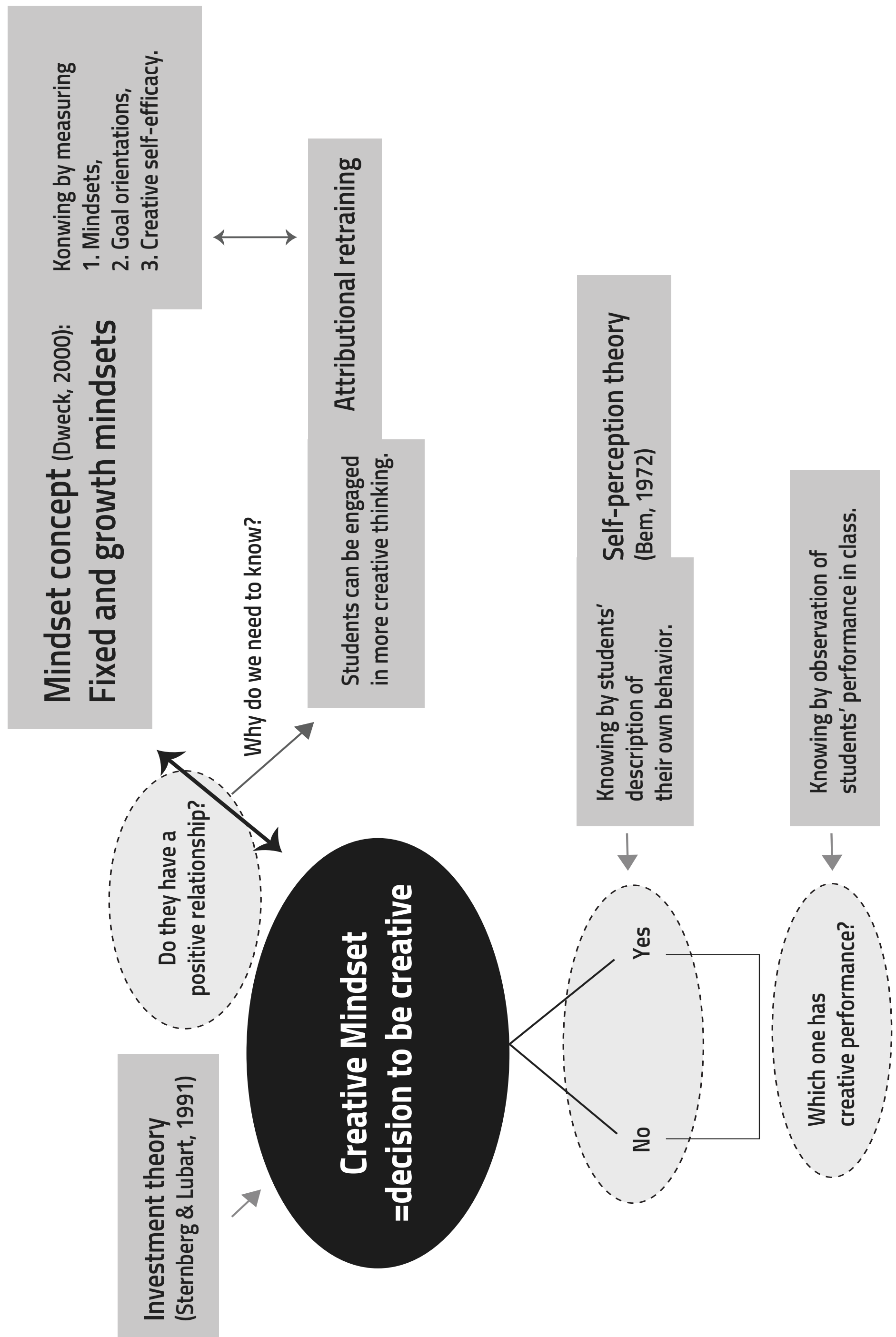

Figure 9. Theoretical Framework: Identifying the Relationship between the Creative Mindset and the Fixed/growth Mindset Concept Regarding Creativity in Design Education.

Objectives	Research Questions
Gain knowledge about the relationship between design students' creative mindset and their attitudes that motivate them to engage in design work creatively.	The first research question discovers whether the creative mindset exists when students are given a design project. A related inquiry to the first question involves how students describe their creative mindsets.
Establish the fact that the fixed and growth mindset concepts can be applied to the creative mindset so that design students can develop their creativity.	The second question examines whether previous findings regarding mindsets can be applied to the creativity domain in regard to design students and whether there is any similarity with the creative mindset. Do design students hold fixed or growth mindsets toward creativity? If they hold growth mindsets, how does a creative growth mindset manifest itself?
Contribute to an understanding of how design students' varied attitudes toward creative design work affect their creativity by incorporating the experiences of growth mindset students and relating these experiences to their creative mindsets.	The third research question concerns how creative mindsets influence students' design processes, outcomes, and ultimately, their success in design education. How do students' creative mindsets relate to design success?

Table 3. Matched Research Questions with the Study Objectives: How the Study Objectives will be Fulfilled via the Research Questions.

Research Questions

The main purpose of this research is to gain knowledge regarding the relationship between design students' creative mindset (decision be creative) and their attitudes that motivate them to engage in design work creatively. The current study aims to establish the fact that the growth mindset concept can be applied to the creative mindset. As a result, design students can develop their creativity; in addition, this study contributes to our understanding of how design students' varied attitudes toward creative work affect their creativity. This notion is illustrated by incorporating the experiences of growth mindset students and relating these experiences to their creative mindsets. Based on knowledge from the literature review in terms of the fixed and growth mindset concepts and creativity, this research regarding growth mindset students' creative mindsets and performance is especially meaningful for design education.

The current study is based on the personal experiences of design students, as well as design educators. The purpose aims to investigate whether design students decide to be creative (creative mindset) when they start a new design project. This study examines whether the creative mindset has a positive connection with the growth mindset in terms of creativity. Such a positive connection would establish the fact that students can develop their creative mindsets in their design projects; it would also support the notion that design educators can adopt attributional retraining as a pedagogical strategy to motivate a growth mindset. Therefore, this investigation will contribute to enhance students' creativity. In seeking to understand these phenomena, the current study addresses three primary research questions.

The first research question discovers whether the creative mindset presents when students are assigned a design project. A related inquiry to the first question involves how students describe their creative mindset.

The second research question examines whether previous findings regarding fixed/growth mindsets can be applied to the creativity domain in regard to design students, and whether there is any similarity with the creative mindset. Do design students hold fixed or growth mindsets toward creativity? If so, how does a creative growth mindset manifest itself?

The third research question concerns how creative mindsets influence students' design processes, outcomes, and ultimately, their success in design education. How do students' creative mindsets relate to design success?

The most important purpose of this research is to achieve its objectives. In order to achieve these study objectives, the research questions should be aligned with the study objectives. The below table shows the matched research questions with the study's objectives.

3. METHODOLOGY

Sampling

Although creativity is an important aspect of design students, there is virtually no research on the creative mindset related with the growth mindset in the design realm (population). As previously mentioned in an earlier chapter, developing the creative mindset is an important value of an educational goal, particularly in design education. For this reason, design students were selected as the participants of this study. Because a training period was involved in using the design tools, and because experience in doing design projects led to a greater likelihood of affecting students' performance and design outcomes, undergraduate design students were the unit of analysis for this study.

Sample preparation: The implicit belief test regarding creativity

Based on visiting two large design lecture courses and two design studio courses, the sample selection process was started from 179 students who agreed to participate in this research since the sample selection of this study was used an existing survey to the design students. The students were enrolled in a variety of design subject matter tracks, such as graphic design, architecture, interior design, product design, and apparel design in a couple of different major universities located in the US Midwest. These students were selected from two introductory-level design classes and two advanced-level design classes.

In the sample preparation process of this study, participants were given the survey to measure their implicit beliefs about creativity, including the fixed/growth mindset test (Hong, et al., 1999; Karwowski, 2014; Hass, Katz-Buonincontro & Reiter-Palmon, 2016the Goals Inventory (GI) test to determine students' goal orientations (Roedel, Schraw, & Plake, 1994), and the self-perception of creativity test (Hong et. al., 1999; Karwowski, 2014; Hass, Katz-Buonincontro & Reiter-Palmon, 2016). Participants were presented with a hard copy of the consent form (Appendix A) before they took the tests. After reading and signing the informed consent forms, the test copies were distributed (Appendix B). The tests took about 10 minutes to complete. The results of the tests were used to select participants identified as having high growth mindsets toward creativity. The test consisted of 20 questions in total. These questions measured the mindset and goal orientations, along with three items to evaluate self-perceptions of creativity. Test questionnaires were adopted from previous research regarding the implicit beliefs about creativity (Karwowski, 2014; Hass, Katz-Buonincontro & Reiter-Palmon, 2016). In this survey, participants indicated their responses to each item with a six-point Likert scale (1=strongly disagree to 6=strongly agree). The collected responses from the survey were analyzed to score and identify high growth mindset students (> 4 growth mindset on a scale from 1 to 6).

Participants

After the students took the fixed/growth mindset survey, high growth mindset toward creativity students were selected to collect data. An in-depth interview was conducted with 12 students who demonstrated a growth mindset toward creativity. Throughout the process of the sample selection and the interviews with the growth mindset students, participant observation was conducted to understand the relationships between the interviews and students' performance/design outcomes. Participation in this study was voluntary. In order to ask students to participate in the current study, classrooms were visited during one of their class sessions. The interviews took about an hour in a quiet area in the building. Each participant was given a $30 gift card as an incentive to participate in the direct interviews.

Data Collection: Grounded Theory with a Qualitative Triangulation

Objectives: The current research aims to gain knowledge about the relationship between design students' creative mindset and their attitudes that motivate them to engage in design work creatively; establish the fact that the fixed and growth mindset concepts can be applied to the creative mindset so that design students can develop their creativity; contribute to an understanding of how design students' varied attitudes toward creative design work affect their creativity by incorporating the experiences of growth mindset students and relating these experiences to their creative mindsets.

The research objectives are related to two different phenomena, which are the creative mindset and the growth mindset in design students. However, these two phenomena may be complementary to each other and may be used to supplement each other. Therefore, a qualitative triangulation design was used for this study. Triangulation is one of the research techniques identified by four basic forms of triangulation. Those four basic forms are data, the investigator, theory, and methodological triangulations. In this study, methodological triangulation is used to 1) increase confidence and reduce bias in the research data to understand a phenomenon from different perspectives; and 3) reveal unique findings that may not be evident or present solely by one method due to the complexity of students' states of mind (Denzin, 1978).

Rationale: In previous research involving fixed/growth mindsets, research subjects are mostly from K-12 students in order to ascertain the relationship between students' mindsets regarding intelligence and their academic achievement (Dweck, 1999; Hong et. al., 1999). Further, the fixed/growth mindset research in education has been developed by collecting data from various age ranges, e.g., elementary to college students, and from many different subjects, e.g., mathematics, natural sciences, and social sciences (psychology and business).

Research regarding mindsets in the creativity domain involves participants in the researchers' study areas: mostly psychology and education (Makel, 2008; Tierney & Farmer, 2011; Karwowski, 2014; Hass, Katz-Buonincontro & Reiter-Palmon, 2016). Research focused on *design students*' decisions and implicit beliefs about creativity is very rare. Although this study is based on existing concepts of creativity, mindsets, and student behavior, the main purpose of this study is to gain knowledge in regard to existing design students' creative mindset and their relationship with design students' creative performance. The current research seeks to discover creative design students' states of mind (thinking styles), the creative mindset, and design students' acts of creative performance. An additional aim of this study is to discover a positive relationship between the creative mindset and the growth mindset toward creativity. Thus, grounded theory is a main part of the research tools in this study, given that this research seeks and conceptualizes latent design students' thinking patterns, relating them to the growth mindset concept.

The main challenge of this study is related to the nature of the educational environment, as well as to students' individual thinking styles and mindsets on creativity and their performance. These factors are complex: they represent situational change processes, and they are multifaceted and multi-actor in nature. In this case, a single method cannot adequately address the objectives or find answers to the previously stated research questions. As a result, multiple methods of observation must be employed.

Methodological triangulation refers to the application and combination of multiple research methods in a study of a single problem or the same phenomenon. The current research is primarily used two different qualitative research methods, with each having a different function, also for a sample preparation, a simple survey (adopted from existing mindset studies) was used to select a good sample.

The sample preparation part uses structured questions, and the deliverables are value-directed answers that evaluate students' positive attitudes (growth mindset) toward creativity. The main research part consists of in-depth interviews and participant observations dealing with exploratory information regarding students' creative mindsets; here, the deliverables are narrative responses and are not statistically relevant.

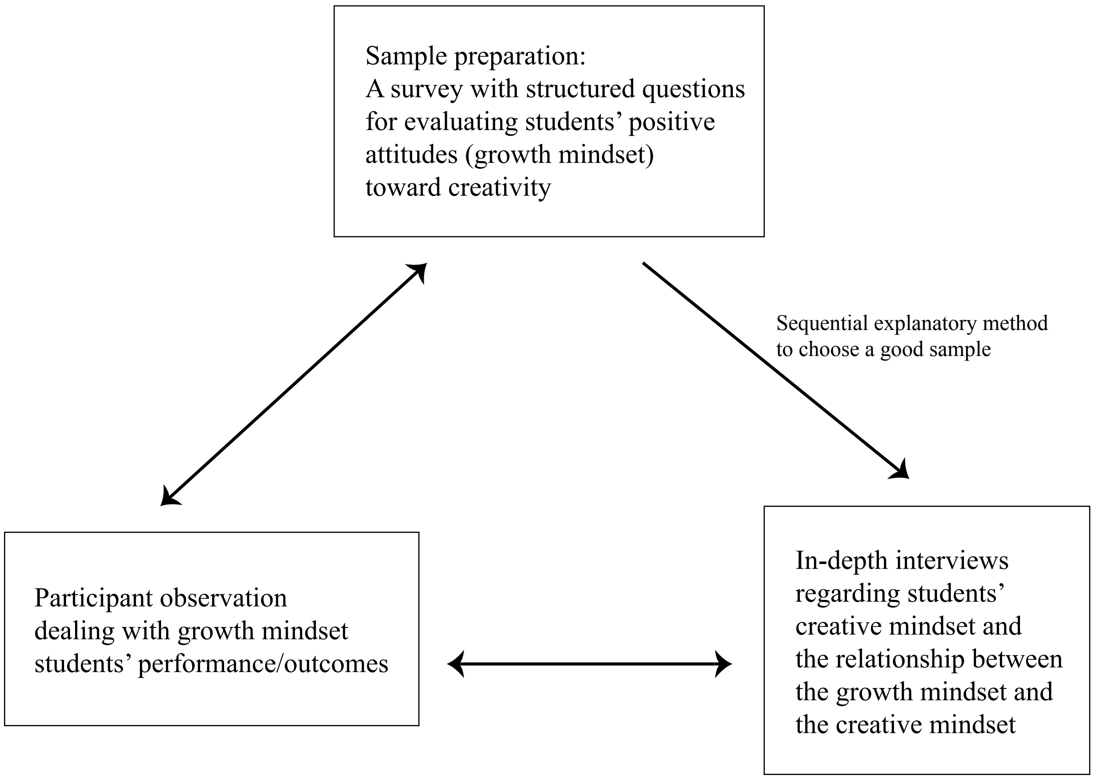

Figure 10. Research Method in the Study: Qualitative Triangulation method.

As discussed in the Literature Review chapter, there is positive relationships among students' self-perceptions of creativity, their creative fixed/growth mindsets, goal orientations, and performance/design outcomes. In order to identify a group of growth mindset students through students' self-perceptions of creativity, goal orientations, and creative fixed/growth mindsets, a survey was conducted the participants. The survey was used to select a good sample for the qualitative research. After the survey, in-depth interviews and observations with the growth mindset students were conducted to discover an emerging pattern and establish a theory that is about how the creative mindset operates and develops with respect to students' creative performance by incorporating the concept of the fixed/growth mindset toward creativity.

There were three phases in the process of the study, which were as follows: a sample preparation with implicit belief of creativity (fixed versus growth mindsets toward creativity) survey, direct in-depth interviews, and observations.

The survey used three different sections of questions that is adopted from existing studies regarding mindsets and creativity: the mindset test (Hong, et al., 1999; Karwowski, 2014; Hass, Katz-Buonincontro & Reiter-Palmon, 2016), the Goals Inventory (GI) test (Roedel, Schraw, & Plake, 1994), and the self-perception of creativity test (Hong et. al., 1999; Karwowski, 2014; Hass, Katz-Buonincontro & Reiter-Palmon, 2016) to identify students with a high growth mindset toward creativity.

After the selection of study participants, direct in-depth interviews were conducted with the students who were identified as having growth mindsets toward creativity. The aim of the interviews focused on how to determine whether students had a creative mindset, as well as to identify the relationship between the creative growth mindset and the creative mindset.

Participant observations were conducted throughout the whole research process. In the participant observations, the primary sources of data were how students behaved and what they said in a natural classroom environment. Through their conscious and/or unconscious behaviors or conversations, students' attitudes toward creative design work could be identified. The purpose of these participant observations was to understand how design students' varied attitudes toward creative design work affect their creative design performance/outcomes by incorporating the experiences of growth mindset students and relating these experiences to their creative mindsets.

Data Collection and Analysis Procedure

Phase 1. In-depth Interviews*:* When the survey was completed, 12 participants with an average score higher than or equal to 4.0 (> 4 growth mindset on a scale from 1 to 6) were selected and agreed to continue to the interview phase. To determine the answers to the research questions, as well as the related questions (Do design students have creative mindsets? How do they describe their creative mindsets? Do creative mindsets have a similarity with the growth mindset regarding creativity?), a qualitative data collection method was used with in-depth interviews consisting of open-ended questions to identify participants' implicit beliefs about creativity and creative mindsets (decisions to be (more) creative).

Direct face-to face interviews were conducted because the observation of social cues such as facial expressions, body posture, or voice tone is an important part of the interview in determining participants' thinking habits, states of mind, and implicit beliefs.

The interviews were designed to collect descriptive data in the participants' own words and to develop an understanding with regard to participants' opinions and experiences. The interviews took approximately one hour each in the participants' design studios, where they usually spend their time in the creative design process on campus. Incentives were given to participants to elicit more active participation, and the interviews were audio recorded after participants signed the interview consent form (Appendix C). When participants signed the consent form, the interview consent was reviewed, including details of the guidelines documenting the interview and assurances of confidentiality. The consent also provided participants with information about the research topic. The interviews were guided by questions created beforehand and proceeded in a conversational manner.

These in-depth interviews sought to probe participants' thinking habits that motivate them to do design work creatively, and to see how they exhibit their growth mindset in creativity and with respect to the creative mindset. The interview questions included the following topics:

1. A description of the participants' own design process, as well as their thought process (thinking habits), from start to finish (If these are different for each design project, how are they different?).
2. Why do you choose Design as your major?
3. A description of their self-perceptions of creativity.
4. A description of creativity and creative mindset for them (from their perspective).
5. A description of the factors (e.g., themselves or external stimuli) that affect them in terms of being more creative (Do these factors develop their creativity? If so, how do they develop their creativity?).

All interviews were recorded and transcribed; moreover, the interview situations were documented in field notes. The data were analyzed through an inductive content analysis, in which "themes and categories emerge from the data through the researcher's careful examination and constant comparison" (Zhang & Wildemuth, 2009, p.2). Indeed, a qualitative content analysis goes beyond merely counting words to examining language intensely for the purpose of classifying large amounts of text into an efficient number of categories that represent similar meanings (Weber, 1990). Additionally, content analysis offers chances to describe attitudinal and behavioral responses to communications, and to determine the psychological or emotional state of individuals (Berelson, 1952).

Analysis: The objective of this analysis was to identify the notable themes and patterns indicating the relationship between participants' creative mindsets (decision to be creative) and the creative design process (Finding themes). Another purpose of this analysis was to determine whether the participants actually changed (developed) their thinking habits. Since this phase (in-depth interviews) was conducted to find answers regarding the creative mindset and growth mindset, these purposes fulfilled research objectives regarding Gain knowledge about the relationship between design students' creative mindset and their attitudes that motivate them to engage in design work creatively; Establish the fact that the fixed and growth mindset concepts can be applied to the creative mindset so that design students can develop their creativity.

During the 60 minutes of each interview, there were large amounts of textual information, with explicit or inferred communication. Throughout the content analysis process, first the contents were transcribed from the recorded interviews. Second, five different tables with each of the five interview questions were made, and the most important information was selected from the transcribed content (Defining the unit of analysis). Third, using different color codes, the content was classified to identify similar themes or patterns (Coding). Then these different themes were organized into several charts. Afterward, a couple of different charts were finally developed, in which these units of meaning were categorized via five different themes (Categorizing/Grouping).

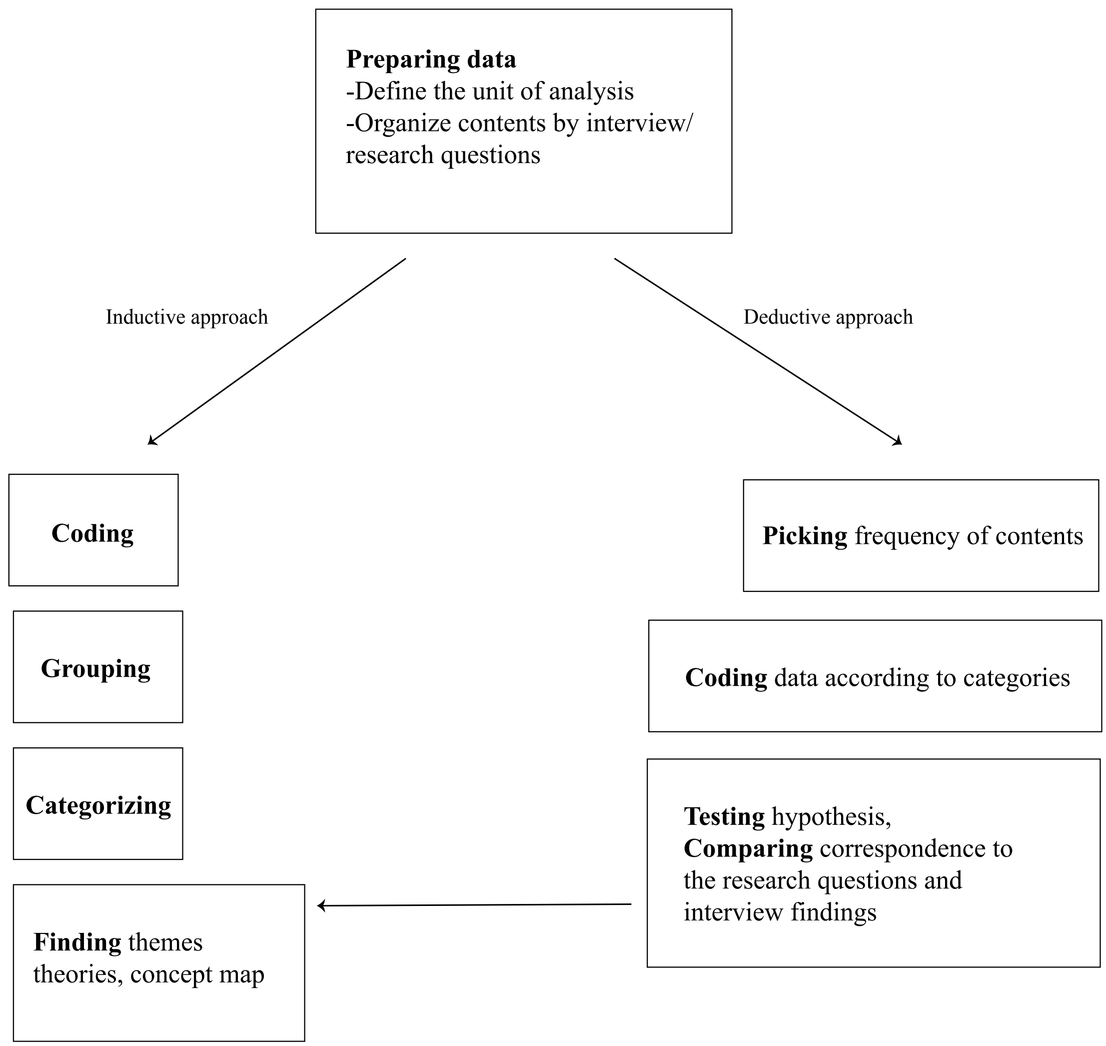

Figure 11. Process of Inductive and Deductive Approaches of Content Analysis.

Phase 2. Observations

The observation phase was conducted in order to fulfill the research objective, contribution to an understanding of how design students' varied attitudes toward creative design work affect their creativity by incorporating the experiences of growth mindset students and relating these experiences to their creative mindsets.

Throughout the entire research process, participant observations were conducted to examine their behavior/performance and outcomes of the creative design process. The observation took place through nonparticipant observation: although the researcher entered the classroom and met with the students directly to ask about their feelings and thoughts about their work, the researcher did not become a member of the context, nor did the researcher participate in their activities (Burns, 1999). The steps of the observation process were 1) deciding when and where to observe; 2) deciding what to observe; 3) collecting objects (documents and photos) in the field; and 4) examining the data (Yin, 2016).

To enhance the validity of the observation data, the observation took four months (one semester) in two different design studio classes that were selected for phase 1 (the tests). Two classes were visited within two time periods (4 hours) a week during the entire semester. The observations were made when the participants were given a new project and time to work on their own. In this way, the relationship between participants' creative mindsets (decision to be creative) and creativity (developing their project) in the design process could be observed through their behavior. In the observations, the researcher was a member of the classes, and thus, drew less attention from the participants being observed so that their behavior and interaction would remain natural.

Students' design processes were observed in detail, starting from the research to the production/presentation in order to record them objectively, without the researcher's personal bias. Throughout the design process, the participants were sometimes asked about their feelings and thought processes regarding their projects, and their responses were documented in written format.

Before the survey results were analyzed, "broadly focused observations" were conducted to glean an overall picture of what was happening in the classrooms (Fraenkel & Wallen, 2003). In this process, two different groups of students were identified with different attitudes regarding their projects. Once the survey results came out, the scores of those with a growth mindset and the two different attitudes of the groups were compared. After the high creativity growth mindset students were determined, "narrowly focused observation" (Fraenkel & Wallen, 2003) was conducted to concentrate on the high-performance students' behavior and outcomes. Photographs were occasionally taken to collect visual data from the participants' design process, such as sketch critiques, ideations, and the progress of their projects. Written documentation was recorded with two types of field notes: one with the research questions and answers to the questions, and the other one with personal observations that may or may not fit the research objectives.

Analysis: To analyze the field notes, 1) the collected data were organized into a narrative format of a day; 2) the narrative format of the information was organized, according to the outline of the research questions; and 3) a deductive content analysis was used, which "starts with the counting of words or manifest content, then extends the analysis to include latent meanings and themes" (Zhang & Wildemuth, 2009, p.2).

The outlined text information was analyzed to determine the frequency of the contents (students' habits of action). This information was later compared to the research questions: how creative mindsets influence students' design processes, outcomes, and ultimately, their success in design education?; How do students' creative mindsets relate to design success? and interview findings to match with students' performance and the creative mindset.

Ethical Considerations

In order to protect the participants in this study, the research design was reviewed by the Institutional Review Board (IRB) to ensure the safety of human subjects and inviolable human rights. The IRB determined that this study met the criteria for exemption from the review, since this research involves the use of educational tests (cognitive, diagnostic, aptitude, and achievement), survey procedures, interviews, and observations of public behavior, with the privacy and anonymity of the respondents guaranteed. The respondents' participation in this study was voluntary, and they had the right to refuse to take part in the research.

The participants were free to decline to answer any particular question that they did not wish to answer for any reason. The participants joined this study on the basis of informed consent (Appendix A). The informed consent provided sufficient information and assurances about taking part in the study, allowing them to understand the implications of participation and to consider/decide about their participation. The survey responses were kept strictly confidential.

Issue of Trustworthiness

The research design used a couple of different approaches for the qualitative data collection. To obtain a good sample rather than randomly selected participants for the qualitative research, survey questionnaires were used. In terms of the reliability for the sample selection, existing survey questionnaires were used, which had already been validated through several different previous studies by Dweck (1999), Dweck and Leggett (1988), Karwowski (2014), and Hass, Katz-Buonincontro & Reiter-Palmon (2016). After the selection process, a grounded theory with qualitative methods was used to define the answers to the research questions.

According to Guba (1981), four general criteria of qualitative research (which are credibility, dependability, confirmability, and transferability) help establish trustworthiness. In this study, triangulation and member checking were used to achieve the four general criteria of establishing trustworthiness. A qualitative triangulation (in-depth interview, and observation) established confidence in the truth of the findings for the study (credibility); furthermore, it demonstrated that the research findings are applicable for other similar studies and contexts (dependability), given that this study design was applied from a similar study subject (fixed/growth mindsets) and context (education).

This study can be replicated to other contexts requiring a high level of creativity, not only for design education, but also other disciplines, such as the sciences, economics, and marketing in higher education (Transferability). Member checking was done during the interview process. Once each participant was done answering the interview questions, the questions and answers are restated and summarized and checked whether the obtained information was accurate. This process provided an opportunity to overcome biases and established a degree of neutrality in the findings (confirmability) (Bloomberg & Volpe, 2012; Lincoln & Guba, 1985).

Limitations and overcoming biases

As with any research there are limitations in the design, implementation of and the sharing of results that legitimize consideration. Primarily, it is important to acknowledge regarding the bias impact and overcoming the bias. The current study is motivated by personal experience, professional passion and concerns, focused on understanding how design students' mindset toward creativity matter to their creative design process and outcome that is based on design students' personal experiences, beliefs, feelings, state of mind and attitude. In general, qualitative, interpretive research allows for the requisite attention to be paid to the nuances and layers of students' experiences without any assumptions and personal beliefs from the researcher. Qualitative research to build a grounded theory depends on the subjective and perhaps biased telling and retelling of personal stories that are often channeled through a single-person perspective. In the nature of qualitative research to build a grounded theory, there are two possible biases that might inherent in the study design, interpretation and construction meaning. The first bias might be a selection bias that relates to the process of recruiting participants who have high growth mindset toward creativity. Successful research begins with recruiting participants who meet the study objectives. To avoid this bias, a survey that has been used in previous creative mindset studies was used to select high growth mindset students in a design area. The second bias might be an analysis bias. Analysis bias can occur when a researcher's personal beliefs influence the process of data analyzing. In this case of current study, when analyzing data, the researcher may naturally look for data that confirm personal experience, overlooking data consistent with personal beliefs. To avoid this bias, a triangulation was used to exam and check the consistency of the findings generated by in-depth interview and observation.

Summary

In order to achieve the research objectives, the creative mindset with high performance design students was defined in order to understand its relationship with students' success in design education; in doing so, a grounded theory with a qualitative triangulation was employed. In this chapter, a detailed process of implementing qualitative triangulation is provided, as well as the instruments used to collect the data, and the analysis processes are addressed. In order to implement a qualitative triangulation, three different phases were conducted.

First, to select a good sample, a survey was conducted to select 12 high growth mindset (> 4 growth mindset on a scale from 1 to 6) students. The creativity implicit belief tests (fixed/growth mindset, self-perceptions of creativity, goal orientation test) were used with 179 students who were enrolled in a variety of design subject matter tracks, such as graphic design, architecture, interior design, product design, and apparel design in a couple different major universities located in the U.S. Midwest.

Second, the qualitative data collection method was conducted using in-depth interviews with 12 students selected from the first phase. These in-depth interviews consisted of open-ended questions to collect descriptive data in the participants' own words and to develop an understanding of the participants' opinions and experiences regarding implicit beliefs and the creative mindset. Recorded and transcribed interviews were analyzed through an inductive content analysis.

Third, participant observation was conducted to examine high performance students' behavior/performance and outcomes of the creative design process. The observations took four months (one semester) in two different design studio classes that were chosen from the participants preparation. During the visits of two times (4 hours) a week per semester, students' detailed design processes were recorded. Using a deductive content analysis, outlined text information was analyzed to determine the frequency of the contents (students' habits of action), and was later compared to the research questions and interview findings to match with the students' performance and the creative mindset.

4. FINDINGS

Overview

Creativity is an essential ability in design. It is imperative to develop and be mindful of creativity in design education. Most traditional design fields focus on creative outcomes that impact revenue, trends, and popularity. However, this current research finds that people's ability to connect with their state of mind, and find willingness, joy, and depth in their work is even more important in building their creative ability. How, then, should design students start their creative design process, and what is the relationship between design students' mindset regarding creativity and their academic success?

Since the creative mindset was defined as the "decision to be creative" in the introduction chapter, students' attitudes toward starting their projects need to be identified. The main purpose of this study is to 1) gain knowledge regarding the relationship between design students' creative mindset (the decision to be creative) and their attitudes that motivate them to engage in design work creatively; 2) establish facts that the fixed/growth mindset concept can be implemented to the creative mindset so that design students can develop their creativity; and 3) contribute to an understanding of how the creative mindset influences students' design process, outcomes, and ultimately, their success in design education. The primary research questions were established by analyzing previous studies and related literature, as well as the researcher's personal experience in design education.

In order to address the above-mentioned purposes, a grounded theory with a qualitative triangulation was used. The growth mindset concept (Dweck, 1999) (using an existing implicit belief survey fixed/growth mindset, goal orientations, and self-perception tests regarding creativity) was applied to identify high creative growth mindset students (Karwowski, 2014; Hass, Katz-Buonincontro & Reiter-Palmon, 2016; Roedel, Schraw, & Plake, 1994, Dweck & Leggett, 1988). Throughout semester-long observations and interviews with these high growth mindset students, the qualitative data established the fact that high growth mindset students have a creative mindset; thus, these students actually develop their creativity. Students' creative mindsets toward design work greatly affect their creativity, as well as their success in design studies.

This chapter presents four primary findings from the in-depth interviews and observations of 12 high growth mindset students who were selected from the implicit belief test regarding creativity. To analyze the qualitative data from the interviews and observations, a content analysis was used to evaluate large amounts of textual information with explicit or inferred communication and situations. This content analysis process focused on concepts rather than words, and on semantic relationships rather than the mere presence of literal meanings. The important matter in this process involves how this outcome compares and contrasts with theories and the literature (Creswell, 2014).

Thus, the primary effort of this analysis was to create links among 1) the discovery of emerging patterns in the data; 2) the expected and unexpected answers related to the research questions so that the notable findings may go beyond the literature and may break new ground; and 3) common threads from the participants' experiences within the various categories to determine the participants' creative mindsets and their ways of developing their thinking habits (Bloomberg & Volpe, 2008).

Results from the Observations

Research Objective: An objective of the observation was to identify students' attitude and performance in their design process so that observation data is presented to help pursuing one of the main purposes of this study: gaining knowledge regarding the relationship between design students' creative mindset (the decision to be creative) and their attitudes that motivate them to engage in design work creatively. As it was previously discussed in the method chapter, the observations involved a two-step procedure throughout the study, encompassing broadly focused observations: an overall picture of what was happening in the classrooms (first step), and narrowly focused observations and specific discoveries regarding high performance students' behaviors and outcomes (second step) (Fraenkel & Wallen, 2003).

Two distinct groups of students with different attitudes toward their design projects were observed and selected from the broadly focused observations. There were students with neutral attitudes in between the two distinct groups; however, only the performance of the high growth mindset students and the high fixed mindset students were observed. Then, subsequently, only the high growth mindset students were selected and were invited to participate in the in-depth interviews. Their responses were then analyzed to address the research questions.

Observation Results: At the beginning of the observation, two different groups were distinguished based on ten attributes that were selected from the frequency of content (students' habits of action). The ten attributes are as follows: 1) Active engagement; 2) Time management; 3) Relevant conversation; 4) Having an open mindset to critique; 5) A high attendance rate; 6) Mindfulness of the project; 7) Generating ideas; 8) Willingness to take challenges; 9) Preparing class materials and assignments; and 10) Sharing knowledge. The attributes are actually shared the concept with the Stenberg's investment theory of creativity (Figure 12): attitudes toward life include the willingness to: 1) redefine problems in novel ways; 2) take sensible risks; 3) sell ideas that others might not initially accept; 4) persevere in the face of obstacles; and 5) examine whether their own preconceptions are interfering with their creative process. These attitudes can be taught and instilled in students through education that motivates them to think about themselves (Sternberg & Lubart, 1991).

These attributes were largely identified from students with high scores of implicit beliefs as having a growth mindset toward creativity. They usually engaged actively in class exercises, worked more than they were required, and managed their time well so that they always stayed on top of due dates. They tried to generate different ways of solving problems in given projects, and they were willing to share their knowledge with others.

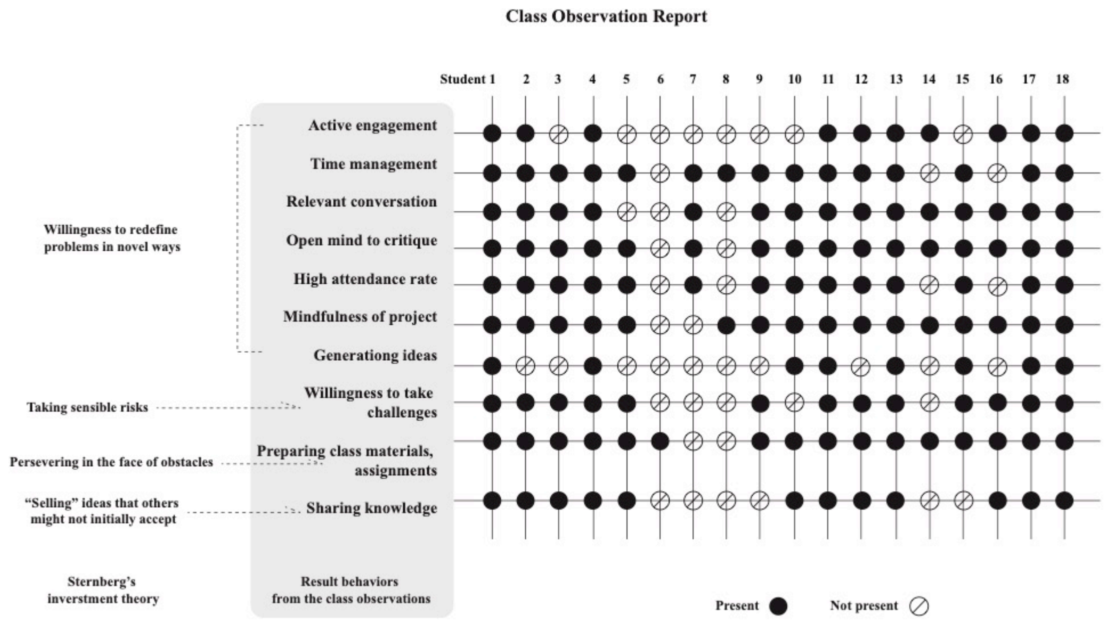

Figure 12. Class Observation Report with related Stenberg's investment theory.

After the high creativity growth mindset students were identified from the survey, the second step of the observations (narrowly focused observations) took place in order to concentrate on high performance students' behaviors and outcomes (Figure 12). These ten attributes were confirmed through students' behaviors during the narrowly focused observations. The most obvious characteristic of the growth mindset students was having an "open mind" among all of the ten attributes. All 12 participants (100% of the growth mindset students) had an open mind in terms of accepting others' critiques, accepting challenges, and collecting different ideas from various sources.

Students with an open mindset versus students showing a less open mindset demonstrated significant differences in their attitudes toward and improvement of a project. Open-minded students were willing to accept others' critiques and shared their feedback with others. Because of this attitude, their projects showed more improvements along the way and finally ended up being higher in quality throughout the design process.

On the other hand, students with a less open mindset complained about having to try different ways to improve their projects. They exhibited negative emotions when they listened to critiques about their projects. They said that trying new ways to change their ideas was challenging, and they wanted to try only “safe” ways to avoid making mistakes. As a result, their projects never went through different iterations in order to be improved, and they stayed at the same level throughout the design process.

However, not all participants with a high growth mindset did well on their project from the beginning. A total of 42% of the participants (5 out of 12 participants) showed a lack of both diverse ideation and development of their final outcomes on their first couple of projects. From the broadly focused observations, there was no significant difference in the first quarter of the semester with respect to their current design skills. However, when there was challenge or confusion in the assignment, the fixed mindset students clearly suffered from their confrontation with the challenge or the confusion. They ended up with the same level of work from the very beginning stage of the design process. There was no improvement throughout the project. They generally reacted with self-doubt and disruption, deciding quickly that they were not good at doing the project. That led them to give up easily. This would put them at a disadvantage to succeeding in the class.

The growth mindset students were equivalent in the design skills that they brought to a task. However, they ended up displaying much different levels of performance and outcomes. From the narrowly focused observations, this appears to have occurred as a result of how they approached the project. Through their open-minded approach to a project, the challenge or confusion of an assignment allowed them to progress and improve in later projects.

It turned out that being open minded was an essential attribute for students in influencing their success in their outcomes. An open mindset led students to enjoy their challenges or obstacles. They also remained very confident that they would succeed, saying things such as, “I almost got it now” or asking for a few more chances on the assignment because they were almost getting it. This group tended to maintain the positive mood they had displayed during a difficult assignment, but some of them become even happier about the assignment.

The images below show the improvement in Student 3’s (from Figure 12) divergent thinking process in the same condition and criteria.

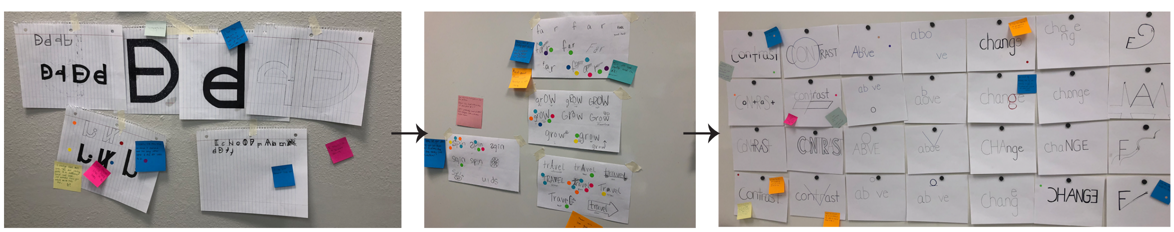

Figure 13. Improvement of a Student’s Idea Generation (Divergent Thinking) Throughout the Semester.

All of the participants reported in their interviews that the idea generation phase required the most creativity in the design process, In Student 3’s case (Figure 13), she showed significant improvement in her design process, even though she had initially experienced difficulty in generating many different ideas. There was a 15-minute time limitation, and the students needed to sketch at least 20 different ideas; however, this student did only eight sketches, with a couple of very similar ideas. According to the observation report of Student 3 (Figure 12), mostly positive attitudes were evident, except for "Active engagement" and "Generating ideas." Student 3 was one of the students with an open mind toward accepting others' critiques, and who enjoyed challenges in the design process. This student's idea generation skills improved in later projects, and ultimately affected her success in the final outcome.

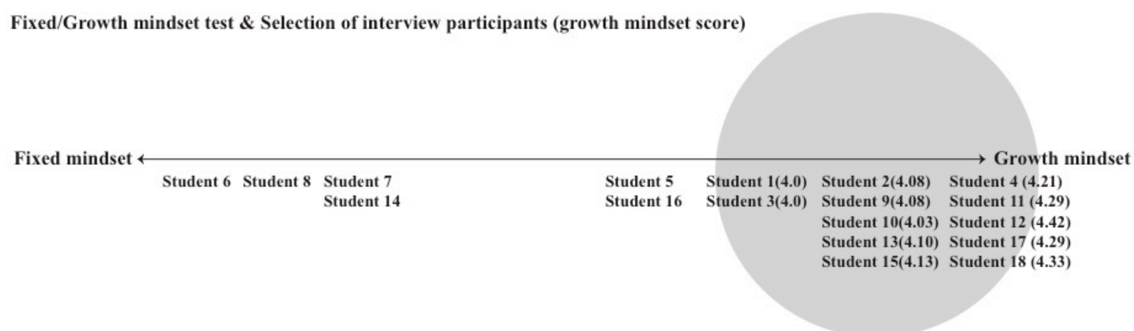

Figure 14. Fixed/growth Mindset Test Result Based on the Observations & Selection of the Interview Participants.

Participants who agreed to do the in-depth interviews

Participants	Students (observations)	Growth mindset score
Participant 1	Student 18	4.33
Participant 2	Student 17	4.29
Participant 3	Student 12	4.42
Participant 4	Student 11	4.29
Participant 5	Student 4	4.21
Participant 6	Student 15	4.13
Participant 7	Student 13	4.10
Participant 8	Student 10	4.03
Participant 9	Student 9	4.08
Participant 10	Student 2	4.08
Participant 11	Student 1	4.0
Participant 12	Student 3	4.0

Table 4. Participant Chart Indicating the Students who Agreed to Participate in the Interviews and Their Growth Mindset Scores.

Results from the Interviews

Research Objective: The main purpose of the in-depth interview was to discover students' state of mind regarding their creativity and their behavior that is influenced by their mindset. Thus the interview data is presented to seek the research objectives: Establishing the fact that the fixed and growth mindset concepts can be applied to the creative mindset so that design students can develop their creativity; Contributing to an understanding of how design students' varied attitudes toward creative design work affect their creativity by incorporating the experiences of growth mindset students and relating these experiences to their creative mindsets.

From the results of the narrowly focused observations and the growth mindset survey, 12 students with a high creative growth mindset were selected. They agreed to participate in responding to the interview questions (Figure 14, Table 4). In the process of analyzing the interview data, the most meaningful information from the transcribed content was selected in defining the unit of analysis. Meaningful information was then classified to identify the primary findings, using four different color codes. The information that emerged in this study represents the experience of high creative growth mindset students who shared their insights and thinking habits, which were creatively illustrated in their design performance. Within the interviews and observations with the 12 high growth mindset students, the participants are identified as Participant 1 through Participant 12 (Table 4).

The expected and/or unexpected analyses were organized as four primary findings. Findings 1 and 2 demonstrate how students describe and act in accordance with their creative mindset. There is a positive relationship between their description and performance of the creative mindset that students exhibit when starting their design project. Finding 3 illustrates the close relationship between the growth mindset concept and students' creative mindset. Thus, by incorporating the concept of the growth mindset into their creativity, students develop their creative mindset and creative performance. Finding 4 provides evidence that design education is greatly influenced for developing the creative mindset; furthermore, this finding highlights certain examples of instructional methods from the participants' experiences. Below are the four primary findings from the participants' responses.

Interview Results:

Finding 1: The students' thinking mode changed to being more open and looking for something more unique when embarking upon a new design project.

Sixty-seven percent of the participants (8 out of 12) with high growth mindsets reported that they "changed" their way of thinking when starting a new project. This "change" means that the participants *got ready* to dive into their projects. In particular, their thinking mode changed to being open and looking for something more unique (the decision to be creative). The participants reported their starting point on a project in the following ways:

> Participant 1: As I start a project, *I always write down my new ideas, and it is always interesting to see how the ideas shift and evolve into something new…* What will make this design and solution special? *I can typically find a deeper meaning that will make my design and solution truly unique and separate from all others*. I also consider, how else could this problem be solved? How can I "break the grid" aka present this in an interesting manner?
>
> Participant 2: …If I am starting a project, I always start by physically writing everything out. Make a list or Mind Map if relevant and necessary. Develop a deep, meaningful idea that the design will be built around. Ask peers for their thoughts...developing ideas that are built upon a meaningful foundation has always been the most difficult. Knowing that the idea will most definitely shift in the process*, this keeps me with an open mind, not being afraid changing my mind…*
>
> Participant 5: In my experience, placing oneself in the client's shoes, yet approaching the problem in *an agnostic manner is the starting point,* and it's the most interesting process. It takes a lot of creativity to explore the unlimited number of directions while maintaining focus on the problem at hand.

Participants 1 and 2 started a design project by writing down a number of random ideas. Participant 5 approached a new project in a free-thinking manner, which involved exploring ideas in an unlimited number of directions. These activities were based upon the concept of the divergent thinking process, which is the primary method of generating a creative idea. In the process of design, ideas evolve, and ultimately turn out to be unique solutions for the project. During my conversations with these participants, I noticed one habit: this process was always expected when they started a project, which changed their thinking mode toward being more open and flexible about exploring ideas.

> Participant 10: I always start with focusing on *how I make this better than the one that is already in the market.*
>
> Participant 12: When I got a design subject to start, *I usually give a great effort to approach a new way of associating things around me to create something new*. I have a science background, so I usually try to connect a design subject with one of the science aspects.

Participants 10 and 12 mentioned that they focus on creating new products that no one has ever done before. This makes them likely to seek surprise associations and do more research to gather enough information in creating a new design. A couple of participants said that they always have an open mind toward finding something more unique, but all of the participants reported that their specific way of altering their thinking mode occurs when they are getting ready to start a new project.

Finding 2: A creative mindset is described as a positive attitude, such as an open mind and readiness toward a design project.

Participants were asked to describe what a creative mindset is in their perspective. The most common descriptions of a creative mindset reported by participants included a "starting point to be creative," "a mind that starts something positively," and "an activity of throwing questions to oneself that are raised from curiosity and interest in something." In this description, the creative mindset is usually apparent at the beginning of the design process. A creative starting point encourages students to have a positive attitude toward their projects. A positive attitude was described using several different words, which were repeated and stressed over time during the interviews: “open mind,” “readiness,” “decide,” and “mode (approach).” Again, a creative mindset is a matter of people’s state of mind and attitude on how they start a project. The participants described the creative mindset as the following:

> Participant 2: *A creative mindset is being really open minded*. Facing fear and challenge with *readiness*. Acknowledging fear and problems that might arise. Finding a way to make the best of a situation. Trust in the process…

> Participant 3: I think that this creative consciousness can affect the outcome of a project. It depends on the mindset, an open mind to everything, of the designer. Having a creative mindset and acting with a creative mindset are never wasted time. I believe that I’ll always gain something from the mindset, and that *is approached with divergent thinking*.

Participants 2 and 3 mentioned that the creative mindset involves being open minded. They reported that having an open mind for divergent ways of finding a solution and being ready to accept a challenge in a project would affect a project’s outcome.

> Participant 5: A creative mindset involves remaining agnostic to what the solution may be… keep questioning like, have I ever had a creative insight into something new and innovative that was separate from the design project I was currently working on? If so, was that an insight acted upon successfully? Do I think that this *creative “mode”* (emphasized) affected the outcome of my project?

> Participants 8: I think that a creative mindset involves thinking about the world and being *willing to find the methods of a solution* or telling a story through a certain medium, whether that be design or art. *A creative mindset that focuses on changing, adding, or sharing to the world around us involves having constant questions about a certain subject that I confront.*

> Participant 9: A creative mindset has to do with *how a person decides to approach* a particular situation, and what their thinking patterns are. It spans across all disciplines, not just artistic ones. I believe it becomes more or less natural to people, but it can be developed and improved…

> Participant 10: A creative mindset is a mind by which someone tries to connect existing things to create new things. For example, someone combines two things

> that nobody has ever thought about, to relate to each other. In order to do that, someone has to be really *open minded,* since there is creativity everywhere.
>
> Participant 12: A creative mindset is something that includes constant ideas, thinking about strange ideas, thinking outside the box, and always having an *open mindset* that is needed when problems are at hand…

Participants 8, 9, 10, and 12 explained that their creative mindset involves being open and ready to explore many different ideas by associating things among unrelated topics. In this way, they eventually end up with a surprise result from the association.

Finding 3: Making an effort to have new experiences and to get external stimuli helps one's motivation to be creative.

One-hundred percent of the students reported that creativity more or less depends on effort. Ten out of the 12 participants actually used the word "effort" in their interviews, and two participants gave examples to show how they make an effort to be more creative. Participants make an effort to have new experiences, since they believe that a creative outcome is based on an individual's experience. Participants' motivation to develop more creative ideas comes from external stimuli (experience).

During the interviews, all of the participants shared their experiences. They said that these experiences triggered their motivation to engage in creative activities. The participants below said that they make an effort to expose themselves to new environments, such as going out to see nature, museums, traveling, meeting friends, and getting a new hobby. They also try to observe their surroundings from different perspectives and from breaking things down and reconnecting them in order to redefine something new. Participant 11 said that she believes an individual's experiences shapes one's creativity, especially experiences involving failure stimulate her to become more creative.

> Participant 1: I think I try to make quite a bit of *effort in being more creative*. When I feel that I need new ideas, I go out to a new environment. I tend to just take inspiration from anything I see and look at it from a design perspective. Nature, design websites, furniture, architecture, etc. and just breaking down its form, color, balance, shape, etc. I think noticing these details helps me be more creative in my designs.
>
> Participant 2: … The *effort helps me be more creative* because I am actively observing other objects and trying to find ways in which I can apply that to my designs. I definitely think creativity levels can differ, based on effort in trying to be more creative. I think lesser creative people just take art and design as it is and don't try to find creative solutions or innovations.
>
> Participant 4: I have noticed that going to museums and places where art and design live is something that always inspires new ideas and projects for myself. *Making the effort to just surround yourself with others works and sometimes gives me the push to start something new*.
>
> Participant 6: I think *there is always a bit of effort needed when starting a new hobby*, but nothing over the top. I usually do low-level research to make sure I have a comprehensive idea of what something will take, and then I do it on my own. The process of figuring it out is where the creativity is reignited…making the hobby or new activity my own.
>
> Participant 10: I naturally take *my effort to find good ideas in my everyday lives*. I observe and find things to connect to each other and mix them together to create something new. It happens when I walk, meet my friends, travel, and even lie down to sleep. I think that my creativity is based on my research. All of my experience can be research because I have a habit of journaling what I feel, see, hear, and read.
>
> Participant 11: The ability to explore creative ideas depends on what kind of experience you have had. *Your experience shapes your creativity*...In my case, creative ideas come from my experts and things that I have already experienced, especially a failed experience. Challenges stimulate my creativity… It should be fueled by curiosity and a drive to be experimental and to try to do new things—either new to yourself or to the world. Even though it's not easy, trying to embrace failure is another part. Those who are innovative often fail the first, second, third (and so on) time.

Participant 5 makes an effort with a little different perspective. This participant said that he has high creativity, but sometimes external factors, such as negative habits, hinder his creativity. Thus, he makes an effort to overcome these negative habits and temptations to help himself become more creative.

> Participant 5: I seek out other people's perspectives on what I'm working on and remove myself from digital temptations. If you have negative habits that disrupt your flow, making the effort to overcome them can help you be "more" creative… Overall, *I think that creativity can be less or more, depending on your effort*.

Participant 7 did not mention the word "effort" in the interview. Rather, she said that the activities in which she engages to maintain her own creative process mainly involve looking for external stimuli, such as critiques, attending collaborative events, and image-based research from social media sites.

> Participant 7: I consciously (and sometimes unconsciously) search for inspiration in my environment. I also love all of those image-based social media sites like Pinterest, Behance and Dribble. I can't say no to looking at pretty things, but those sites also come in handy for inspiration searching or finding new styles to try. Going through all of the studio courses and the critiques with that have helped my creativity immensely. It helps to hear other peoples' opinions, plus learning from instructors. You also learn how to expand and hone in on your own creative process. I also enjoy attending collaborative events like workshops and conferences. I've have learned so much from those, and it has maintained my curiosity.

Finding 4: Education plays an important role for students in having a creative mindset (real-world problem-based learning, opportunities to support peers' creativity).

Finding educational factors that encourage students' creativity would be one of the most important parts for future study. Unexpectedly, the participants mentioned the importance of education in affecting their creativity during the interviews. The importance of education in creativity was identified from the interview question: "A description of the factors (e.g., any activities that you do before a creative work, or thought…) that affect you in being more creative." This question was designed to define how participants develop their creative mindsets, and how the creative mindset affects their project success. The participants said that studio classes motivate their creative mindsets. Because a studio class mainly focuses on experience-based learning (creating things with their performance), it usually leads to their spontaneous project process. They plan, research, ideate, sketch, and make their projects. This process makes them think creatively. Ninety-two percent of the participants shared their experiences from design studio classes, and they are mostly motivated by the types of design projects.

The first type of project is one that has clear and specific goals to apply to a real situation. This type of project motivates students to actively engage in the project. This positive attitude enhances their creativity. Participant 5 discussed a project about building environmental graphics and a wayfinding system. This project was intended to create cost-effective and visually effective solutions for an inside space in a design department building that the participants use every day.

> Participant 5: We redesigned a wayfinding system for a space in the building where we work every day. The building is an outdated old facility. My research and design could be a proposal for redesigning the building later. It makes me excited to do the project. I did a survey with the students and professors who use this building to know their needs. I felt that this process motivated me to be more creative because my design could reflect people's needs, as well, and has the potential to be used to improve our environment.

The second type of project is an assignment with an interaction between teaching and learning. This was a great opportunity to hear unexpected stories about interactions between teaching and learning. The participants said that interactive support is very helpful in being creative. Motivation to be creative comes not only from an instructor's support (lectures, feedback), but also the participants' own support of others.

> Participant 6: …One of the team projects was to conduct research on an assigned historic era from Design History. Our team had to create presentation material containing many visual references and historic information. And then we had to give a lecture to the class using the material. After we finished the lecture, we did a workshop for other students to create artwork using an art style from the history lecture. Our charge for the workshop was to encourage students to make artwork "creatively." It was interesting to think about strategies that we can employ to help someone be creative. And I was fascinated to see the growth of the students… I was able to expand my thinking and figure out how to make their artwork better, which I think was really hard. But I think that really helped. I think that it improved my creativity.

The third type of project is a project requiring constructive critique, which involves specified instructions on how to give feedback. The participants reported that the constructive critique process makes them have an open mind in terms of accepting others' critiques. Also, it gives the participants confidence to give their feedback to others, since there are guidelines. At the same time, there is a chance for the participants to think about their own design. In this way, they are positively challenged by the critique process. Students are encouraged to be more creative when they have chances and options.

> Participant 11: Before I had the critique, I didn't even know how to say, or what to say to others' work. I sometimes said, "I like the color." "I like the way it is used in your design"… But I know that this can't help others develop their designs. We had a constructive critique for our 4^{th} project. We were in groups of four. Our group had to give feedback to the whole class. The professor gave us a sheet with a list containing a bunch of items. The items tell where and how to look at others' designs and ways to give a feedback (at least one suggestion to improve the design, and at least one comment of what and why it is good). At first, our team discussed the design based on the list on the feedback sheet, wrote our comments on the sheet, and moved on to the next design. Once we finished the critique and came back to my design, my feedback sheet was full of helpful comments. This whole process made me think about how to make others' work better, and this thinking process gave me a chance to think about how my design can be better. I actually came up with a better and pretty creative idea for my design while I was doing this critique.

Summary

This chapter presented the findings from the observations and in-depth interviews. The participants with a high growth mindset toward creativity were selected from the implicit belief test regarding creativity. Data from the documentation of the observations and individual interviews revealed 1) how students' decision to be creative (a creative mindset) influences their attitudes that motivates them to do design work creatively; and 2) whether the concept of the growth mindset can be implemented in building students' creative mindsets to see how they develop their creativity. The findings are supported by images that were collected from the observations and quotations from the interviews. By using the participants' own words, the reality of the participants and the situations were accurately presented.

The ten main characteristics and the creative performance of the growth mindset students were identified by the observations. The ten common attributes of the growth mindset students are the following: 1) Active engagement; 2) Time management; 3) Relevant conversation; 4) An open mind to critique; 5) A high attendance rate; 6) Mindfulness of the project; 7) Generating ideas; 8) Willingness to take challenges; 9) Preparing class materials and assignments; and 10) Sharing knowledge. The participants also generally showed extensive improvement in their design process throughout the semester because of their attitude with respect to having an open mind. The descriptions of the high growth mindset students' state of mind and creative mindset were defined through the interviews. Based on the data, four findings were discussed. The four major findings are as follows:

1. High growth mindset students reported that they “change” their way of thinking when they start a new project. Their thinking mode changes to being open and looking for something more unique (the decision to be creative).
2. A creative mindset is described as a positive attitude, such as having an open mind and being ready to take on a design project.
3. Making an effort to have new experiences and get external stimuli develops the motivation to be creative.
4. Education plays an important role for students in developing a creative mindset (real-world problem-based learning, opportunities to support peers’ creativity).

These findings are discussed in the next chapter in order to interpret the findings and address the research questions.

5. DISCUSSION

The current study explored the relationship between design students’ creative mindset and their attitudes that motivate them to engage in design work creatively. This study attempted to examine the fixed/growth mindset concept in the creativity domain, which allows students to develop/change their mindset in a positive way. The primary purpose of the current study was to develop a better understanding of how students describe, use, and develop their creative mindsets, and how the creative mindset influences students’ design process, outcome, and ultimately, their success in design education.

To understand and interpret the meanings of students’ description regarding their state of mind and experience of related behaviors, semester-long observations and in-depth interviews were conducted in the spring semester of 2018 with 12 high creative growth mindset students. Despite remarkable previous studies on the fixed/growth mindset in academic fields, studies regarding the relationship between the concept of the fixed/growth mindset and the creative mindset, which motivate creativity within design education, remain underrepresented. The following is a discussion of the major findings and conclusions reached from the study. This discussion is followed by implications, limitations of the study, and recommendations for future research.

Discussion of Significant Findings

The research presented in this study addressed three primary research questions. Three questions were designed to address the overall aim of the study to contribute to the body of literature regarding students' decision to be creative, the concept of the growth mindset, and creativity in order to determine how the creative mindset is important, and how the creative mindset can be developed.

The first research question examines whether the creative mindset exists when students are given a design project. A related inquiry to the first question is how students describe their creative mindsets. The second question examines whether previous findings regarding mindsets can be applied to the creativity domain in regard to design students, and whether there exists a relationship in terms of the creative mindset. Do design students hold fixed or growth mindsets toward creativity? If they hold a growth mindset, how does a creative growth mindset manifest itself? The third research question concerns how creative mindsets influence students' design processes, outcomes, and ultimately, their success in design education. How do students' creative mindsets relate to design success?

In order to answer these research questions, four major findings are addressed in the previous chapter, which are as follows: 1) The students' thinking mode changed to being more open and looking for something more unique when embarking upon a new design project; 2) A creative mindset is described as a positive attitude, such as having an open mind and being ready to take on a design project; 3) Making an effort to have new experiences, and obtaining external stimuli help one's motivation to be creative; and 4) Education plays an important role for students in developing a creative mindset (real-world problem-based learning, opportunities to support peers' creativity).

These major findings contribute to defining the conclusions of the research objectives. Based on these findings, this study provides four important concepts, which involve: 1) the creative mindset; 2) the relationship between the creative mindset and the concept of the growth mindset; 3) the relationship between the creative mindset and students' performance/success in a project; and 4) factors developing the creative mindset in design education.

1) The creative mindset (Decision to be creative): The creative mindset involves students' attitudes toward design projects and is manifested as a positive attitude, such as an open mind and readiness, which is evident at the beginning of their design process.

This concept of the creative mindset is highly meaningful in terms of dealing with the first research question, which examines whether such a creative mindset exists when students are given a design project, and how the creative mindset is manifested. Although the way in which the creative mindset was expressed differed, depending on the participants' experience, *all of the participants articulated the notion that their "decision* *to be creative" occurs at the beginning of their project.* The creative mindset is generally seen in students' performance, which is indicated by a positive attitude, such as having an open mind and being ready to take on the project.

As previously addressed in the finding chapter, all participants shared their experience regarding their design process. They reported that their design process is quite consistent with every type of project, and at the outset, their research, idea elaboration, and ideation sketches demand the most creativity in the design process. In this way, they consciously or unconsciously "change" their thinking mode to be open minded and to look for something more unique (the decision to be creative).

This creative way of starting a project encourages students to have a positive attitude toward their projects. This positive attitude was described using several different words, such as "open mind," "readiness," "decide," and "mode (approach)." Also, these positive attitudes could be found from the following ten attributes: 1) Active engagement; 2) Time management; 3) Relevant conversation; 4) Having an open mind to critique; 5) A high attendance rate; 6) Mindfulness of the project; 7) Generating ideas; 8) Willingness to take challenges; 9) Preparing class materials and assignments; and 10) Sharing knowledge that was identified during the observations. Again, the creative mindset is a matter of people's state of mind and attitude in terms of how people start the design process.

2) Relationship between the creative mindset and the concept of the growth mindset: The positive attitude from students' creative mindsets is closely related to learning goals (Roedel, Schraw, & Plake, 1994), which is one of the main concepts of the growth mindset. Fixed/growth mindsets are involved in creativity. The growth mindset is manifested by a conscious effort to look for something new and develop

creativity. For most of the time, participants keep looking for surprise associations in creating a new design.

"Creative mindset" vs. "Growth mindset toward creativity" in this study

Creative mindset	**Decision to be creative** Thinking habits Attitudes Decision to generate new ideas, analyze these ideas and sell the ideas to others (Sternberg, 1988) The willingness to: 1. redefine problems in novel ways; 2. take sensible risks; 3. sell ideas that others might not initially accept; 4. persevere in the face of obstacles; and 5. examine whether their own preconceptions are interfering with their creative process (Sternberg & Lubart, 1991)
Growth mindset toward creativity	**High growth mindset toward creativity** Implicit beliefs regarding creativity: self-perceptions of creativity How people think about their own creativity: They think that their creativity can be developed. Beliefs about the malleability of own creativity (Dweck, 2000). The positive conceptions of psychological states that are held by laypeople (Sternberg, 1985). Correlated with a learning goal orientation: The goal is to increase competence, and seek challenges that fostering learning Correlated with creative self-efficacy

Table 5. Difference between the Creative Mindset and the Growth Mindset toward Creativity in this Study.

Unexpectedly, an answer to the second research question was identified during the interviews about the creative mindset. Thus, the creative mindset is related with the concept of the growth mindset. The second research objective aimed to determine whether previous findings regarding the fixed/growth mindset concept can be applied to the creativity domain in regard to design students, and whether there is a relationship with the creative mindset.

The notable relationship between the participants' description of the creative mindset and the concept of the growth mindset could also be found from the literature. Fixed/growth mindsets stem from the notion that achievement in academic settings and efforts toward academic goals can be influenced by an individual's mindset toward his or her abilities (Dweck & Leggett, 1988). The growth mindset has been found to be related to motivational constructs, especially the development of learning goals. According to the concept of learning goals, those holding a learning goal orientation are often motivated to master a task and increase their competence. In this process, a positive attitude is always involved in overcoming challenges and exerting more effort because the positive attitude maintains one's confidence about task success and task enjoyment. It reflects the desire to learn new abilities, master new tasks, or understand/accept new things (Dweck & Leggett, 1988).

For this interview question, the participants reported that having a creative mindset always leads to gaining something new because of their open mind and readiness. An open mind allows people to have the desire to learn/try new things and master new projects successfully. Readiness for a project helps people overcome challenges. The creative mindset is a thinking pattern in which a person decides to approach solving a particular situation/problem creatively. This way of approaching a situation/problem leads a person to focus on more efforts to develop his or her creativity.

In order to achieve the second objective for the current study, the participants were asked to answer the question: "Do design students hold fixed or growth mindsets toward creativity? If they hold a growth mindset, how does a creative growth mindset manifest itself?" All of the participants reported that creativity depends more or less on effort. The belief regarding the malleability of one's own abilities is an essential concept of the growth mindset (Dweck, 1999).

Surprisingly, only one participant could explain what the growth mindset is, but 100% of the participants believe in the concept of the growth mindset. Students' growth mindsets are manifested by a conscious effort to look for something new and develop creativity. As for the second finding, an open mind toward new and innovative ideas, participants are generally open minded and ready to explore many different ideas by making associations among unrelated areas or ideas so that they eventually end up with a surprising result from the association. This process usually comes from the participants' creative mindsets at the beginning of the creative design process.

3) Relationship between the creative mindset and students' performance/success on a project: The creative mindset greatly affects the outcome of the design, more specifically, in terms of improving their design ability, which results in student success from a long-term perspective.

This concept is mainly found from the observations. The growth mindset students, who start with creative mindsets, have a positive attitude toward design projects. As discussed in terms of the first concept, a positive attitude was associated with these behaviors: 1) Active engagement; 2) Time management; 3) Relevant conversation; 4) An open mind to critique; 5) A high attendance rate; 6) Mindfulness of the project; 7) Divergent thinking; 8) Willingness to take challenges; 9) Preparing class materials and assignments; and 10) Sharing knowledge.

These positive behaviors significantly improve both the process and outcome, which ultimately affect students' grades in the class and their portfolio development. According to the findings of the study, half of the high creative growth mindset students did not engage in the creative design process, such as divergent thinking, rich ideation, and brainstorming during the first couple of projects. However, they likely possess self-esteem in their performance, which is a positive way of experiencing the creative process when they are fully engaged and are using their abilities to pursue the values of the class (Dweck, 1999).

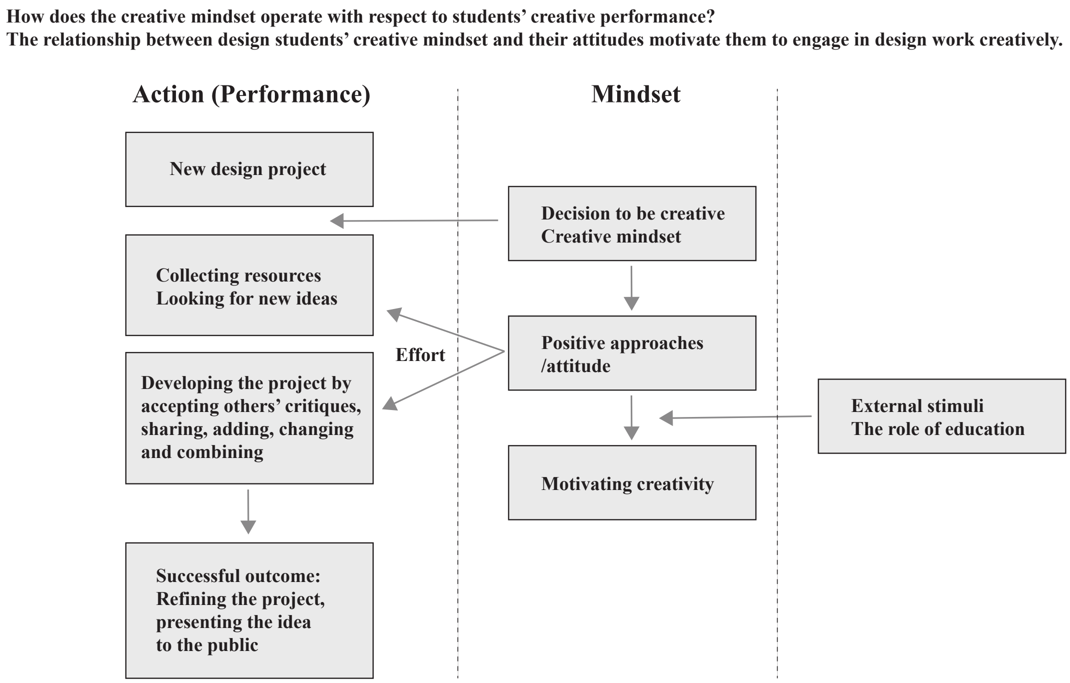

Figure 15. Relationship between Mindset and Action.

When the students experienced failure in their assignments, they did not focus on the reasons for the failure. In fact, they did not even seem to consider themselves to be failing. This phenomenon was discovered by the fact that they did not make any excuses for their failures. Certainly, they actively began learning from the situation in which they failed so that they could improve their performance. Some of their strategies for dealing with failure involve "self-motivating instructions" (Dweck, 1999), which reminds them of what they have learned so far about the experience they are working on. Most of the students in the high creative growth mindset group engaged in the learning process, using self-instructions in order to support their performance. The students welcomed the chance to confront and overcome these challenges.

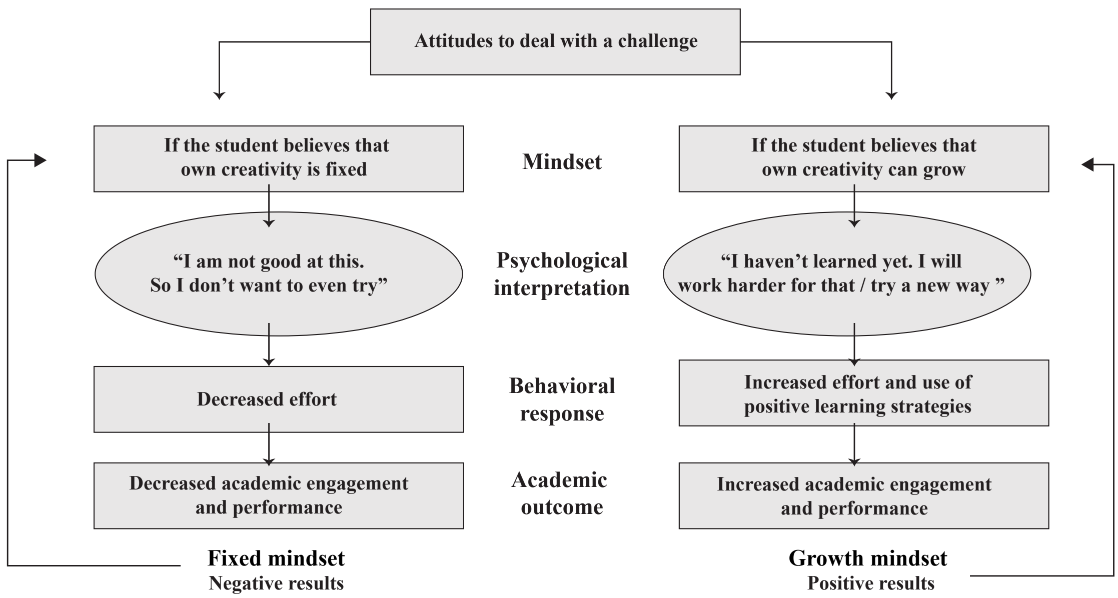

Figure 16. Different Attitudes from the Two Distinct Groups (the Broadly Focused Observations).

In line with their optimism and their efforts, most of the students in the high creative growth mindset group (more than 80%) maintained or improved the quality of their strategies during difficult assignments. They learned new and more sophisticated strategies to address the difficult problems from their own situation. Thus, even though they were no better than the fixed mindset students in the original difficult assignment at first, they ended up showing a much higher level of performance, improving their design abilities and making the project better.

4) Factors developing the creative mindset in design education: The creative mindset can be developed/raised through learning.

Based on the concepts that have been discussed in this chapter, achievement in design education and efforts toward creative performance can be influenced by the creative mindset. How, then can the creative mindset be elicited and developed? During the interviews with the high creative growth mindset students, they shared their experiences of when they were motivated and felt encouragement to engage in creative performance. The most common aspect of motivating their creative mindset was an instructional activity and/or experience that encouraged them to have an open mind and to be intrinsically motivated. The results contribute to the concept of attributional retraining. As previously discussed in the literature review section, Attributional retraining is referred to as motivation-enhancing treatment and is one of the most significant applications of fixed/growth mindsets. Attributional retraining modifies one's cognitive attributions and is designed to enhance motivation and encourage achievement by changing how students think about their academic successes and failures (changing the attributions they assign to their outcomes); in doing so, their beliefs can work for, rather than against their effort toward academic success (Andrews & Debus, 1978).

The key words for the common aspects of motivating students' creative mindsets, such as an open mind, intrinsic motivation, education, and experience/activity are all related concepts. As previously discussed, the creative mindset creates powerful, intrinsic motivations within people as antecedents to their behavior. Collins and Amabile

(1999) reported that student creativity is linked with high levels of interest, enjoyment, and curiosity (intrinsic motivation).

Active learning is a process by which students engage in activities (actively doing something), such as discussion, participation, hands-on workshops, or problem-solving that promote students' interest, enjoyment, and curiosity in their learning. Active learning is experiential, mindful, and engaging. (Dale, 1969). Through active learning (e.g., exploring a set of learning experiences that can be more effective and interesting), these students take more responsibility for their own education.

Reading a book, listening to a lecture, looking at a graph, or watching a movie are examples of passive learning, while participating in a hand-on workshop, going through a real experience, group discussion, and teaching someone are examples of active learning (teaching and learning interaction). Active learning was defined from the interviews when most of the participants in this study talked about a close connection between "actively doing something" (design processes) and a "willingness to do a project creatively" (creative mindset). Below factors are more detail information from the interviews which is closely related to the active learning.

1. Active learning focused on what they "actively do"

In the interviews, common opinions consistent with active learning were found from the study participants. The participants reported that creativity is an activity intended to find new, innovative challenges that change a situation for the better. They also reported that creativity is not merely about a new product (outcome); rather, creativity is a process by which a person comes up with something new. They said that a design studio class, as opposed to a large lecture class, motivates their creative mindset. Because a studio class is mainly focused on creating things using the design process, it usually leads to their spontaneous activity to create outcomes. They plan, research, ideate, sketch, and make their projects. This process makes them think creatively.

Basically, all of the participants have had positive experiences in design that required hands-on skills. This made them more likely to consider choosing design as their major. Due to this characteristic of design students, a course with opportunities to *do* practical projects and *participate* in real-life experiences will be more likely to motivate their creativity. Participating in real-life experience through design works, such as real-world problem-based projects and community-based work, would allow students to generate ideas and would encourage them to move forward in their creative projects.

This kind of course, such as a design studio course that adopts a real-world problem-based project, requires a step-by-step process to solve problems. A creative mindset is involved during this process. The students said that every single time a new project was in front of them, they asked themselves how they could execute the project more creatively. Also, the active learning process makes students more likely to spontaneously plan and lead their projects so that their choices are applied at every step.

2. Opportunity to support a peer's creativity

An interaction between teaching and learning fosters a creative mindset. The meaning of "teaching" here indicates helping and supporting someone to be creative, while "learning" indicates receiving someone's support and encouragement in order to be creative. The participants said that a peer's engagement and encouragement, such as feedback, less negative criticism, more acceptance of diversity, and allowance for failure all motivate them to be more creative. Moreover, while they attempt to figure out how to make others' projects better, it enables them to expand their own thinking. Thus, the interaction between teaching and learning positively impacts an individual's creative mindset and provides them with an opportunity to support their peers' creativity while enhancing their own.

3. Relationship between external stimulation and intrinsic motivation

Clear guidelines (on how to give feedback) provide students with specific goals to develop their work and open their minds to accept others' critiques. Based on the participants' experiences, receiving only praise for their work and having the ability to engage in the design process do not foster motivation or lead to creative accomplishments. They were able to give the most effective and helpful feedback when they have guidelines of where to focus on others' work, what to comment on, and how to make others' work better. This way of giving comments encourages students who get feedback to be more creative (willing to develop).

Intrinsic motivation, which is strongly related with a creative mindset, arises from these external stimuli, such as teaching and learning relations, unrelated events, loose but constructive ways of learning, and unconventional ways of approaching problems.

Students said that a loose, but constructive learning environment gives them the freedom to think about and do things; in this way, they are positively challenged. They are encouraged to be more creative when they have chances and options. Using unconventional ways of approaching problems is fun and enjoyable for them. These students feel that their creativity is tapped when they are involved in unstructured situations. They believe that the most creative ideas come from unrelated events. From students' reports of unrelated events, it is evident that they develop creative ideas when they are engaged in something different from the problem that they need to solve (e.g., talking with friends about a TV show, driving a car while traveling, daydreaming, eating food, etc.).

Implications

Creativity is an important problem-solving tool in the design context. People who are in design education treat creativity as an important component of their self-identity. However, depending on people's attitudes toward their project, some design solutions are more creative, while others are considered as less creative. Attitude explains how people approach design projects; before forming their attitudes, they have their thinking habits. The study is focused on design students' thinking habits toward their design project: how their thinking habits affect their design outcomes and success in design education. As discussed in the literature review chapter, these thinking habits can be explained by the decision to be creative (the creative mindset). The primary research objective is to determine the presence of design students' creative mindset, how it is manifested, and how the creative mindset operates and develops with respect to students' creative performance by incorporating the concept of the fixed/growth mindset toward creativity.

The major findings of this study could provide a number of important ways to improve pedagogical strategy, utilizing the concept of the growth mindset within a design education context. First, the factors that contribute to a student's creative mindset will contribute to developing a better design curriculum by integrating real-world problem-based projects and community-based works.

Second, instructional factors can help educators set goals for class activities, such as giving students an opportunity to support their peers' creativity and setting constructive guidelines for critiques in the design process.

Third, knowledge about the relationship between the creative mindset and the concept of the growth mindset will help educators create an instructional environment and situation that can ignite students' creative mindsets, such as unconventional ways of approaching design problems and introducing unrelated events. Particularly, creating a good atmosphere for the first impression of a project is important in leading students' creative mindsets, since the creative mindset involves students' attitudes toward the design project at the beginning stage. Also, the growth mindset is always involved in the process of creative thinking. As a result, educators can take advantage of situations in which students might express unexpected and surprising ideas. From this situation, educators praise the process and effort of creative thinking more than the outcome/creative ability, which is very important in encouraging students' intrinsic motivation.

Fourth, the explicit knowledge regarding the creative mindset can support students' intrinsic motivation so that first, they believe that creative skills can be developed, and second, they can consciously make an effort to have positive emotions and attitudes toward their project to develop their creative mindset. Thus, by incorporating the concept of the growth mindset, an instructional element should include examples of how creative achievements are acquired after a process with multiple challenges to highlight the role of development and effort in the creative process. For this reason, it is necessary to emphasize all of the above-mentioned findings in design education.

Limitations and Future Study Directions

This research contributes to current design education and expands the literature in the research of mindsets by providing additional knowledge regarding the relationship between the creative mindset and creative performance. However, this research also has limitations stemming from three issues:

1) there was limited diversity in the interview cases conducted. The current study examined students with a growth mindset toward creativity. As a result, the findings were based on data from those who have a creative growth mindset. These interviews could have been conducted not only with growth mindset students, but also students with a fixed mindset toward creativity. Also, in interpreting the data, students with a growth mindset and a fixed mindset could be compared to discover more specific solutions to developing and/or changing students' mindsets;

2) there were limited elements of variables in the participant sample selection. During the interview process, several questions came up, since the participant sample was quite broad. The participants were selected from a variety of design subject matter tracks, such as graphic design, architecture, interior design, product design, and apparel design at a couple of different major universities located in the U.S. Midwest. They were selected from two introductory-level design classes and two advanced-level design classes. However, the sample selection could be divided into different categories, depending on different variables, such as educational background, level of expertise/skill, and major;

3) there is a limitation in generalizing the results of the study to other populations, given that the sample of the current study was collected from college design students. There are interesting population groups that might able to expand the generalizability of the results.

These questions came up during the interview process regarding the impact of these different variables so that the data might be able to provide a deeper understanding about students' mindsets. What if the students' different educational backgrounds affected their state of mind and thinking habits? What if the different levels of students' design skills facilitated or hindered their creative mindset? What if there were more specific suggestions from each different major regarding the educational factors that develop the creative mindset? Can the result be applied to other disciplines than design?

Therefore, these inquiries lead to future research directions. From the perspective of design education, we can broaden the discussion about any other possible elements that affect students' creative mindset and can expand this study to contribute to other disciplines. The first recommendation for future research is to examine the level of inequality between students with growth versus fixed mindsets.

The current research dealt with finding the phenomena of influential aspects from the creative mindset by relating it to the concept of the growth mindset in design education. Thus, the finding concerning the relationship between the creative mindset and the creative growth mindset is still critical. However, there should be a comparison of mindsets, performance, and outcomes between students who have a high growth mindset and a high fixed mindset to examine how these different mindsets affect students' creative design process, outcomes, and their resulting success and happiness. Since there are unexpected findings regarding the factors that help ignite the creative mindset and suggestions to develop students' creative mindsets, this comparison process would provide a better understanding of fixed mindset students and could provide more specific solutions to them.

The second recommendation for future research is that the various interesting factors that ignite the creative mindset could be emphasized and developed in depth to come up with specific implications for pedagogical strategies. Furthermore, interdisciplinary collaborations may be made, since the result could be implemented in other disciplines that require high creativity or creative design thinking, such as the sciences, applied economics, and business in higher education.

The third recommendation for future research is that the concept from this study could be undertaken among professional designers (Pro-C), who are experiencing different states of mind in different types of projects to see how these professional designers maintain their creative mindsets. Also, it would be interesting if this study could be broadened to the Big-C area. For example, a similar study using the same criteria may be undertaken among other professionals (scientists, authors, entrepreneurs, etc.) with significant achievements, such as Nobel Prize recipients or those who have contributed to major transformations within their fields.

Objectives	Research Questions	Research Conclusions
Gain knowledge about the relationship between design students' creative mindsets and their attitudes that motivate them to engage in design work creatively.	The first research question gains facts whether the creative mindset exists when students are given a design project. A related inquiry to the first question involves how students describe their creative mindsets.	**The creative mindset involves students' attitude toward design projects and is manifested as a positive attitude, such as having an open mind and demonstrating readiness, shown at the beginning of their design process.**
Establish the fact that the fixed and growth mindset concepts can be applied to the creative mindset so that design students can develop their creativity.	The second question examines whether previous findings regarding mindsets can be applied to the creativity domain in regard to design students, and whether there is a relationship with the creative mindset. Do design students hold fixed or growth mindsets toward creativity? If they hold growth mindsets, how does a creative growth mindset manifest itself?	**The positive attitude from students' creative mindset is closely related to a learning goal, which is one of main concepts of the growth mindset. Fixed/growth mindsets are involved in creativity. The growth mindset is manifested by a conscious effort to develop/look for creativity. For most of the time, participants keep looking for a surprise association with a new design.**
Contribute to an understanding of how design students' varied attitudes toward creative design work affect their creativity by incorporating the experiences of growth mindset students and relating these experiences to their creative mindsets.	The third research question concerns how creative mindsets influence students' design processes, outcomes, and ultimately, their success in design education. How do students' creative mindsets relate to design success?	**The creative mindset greatly affects the outcome of design work, and more specifically improves design ability, which leads to student success from a long-term perspective. The creative mindset can be developed/ enhanced through learning.**

Table 5. Matched Study Objectives, Research Questions, and Study Conclusions.

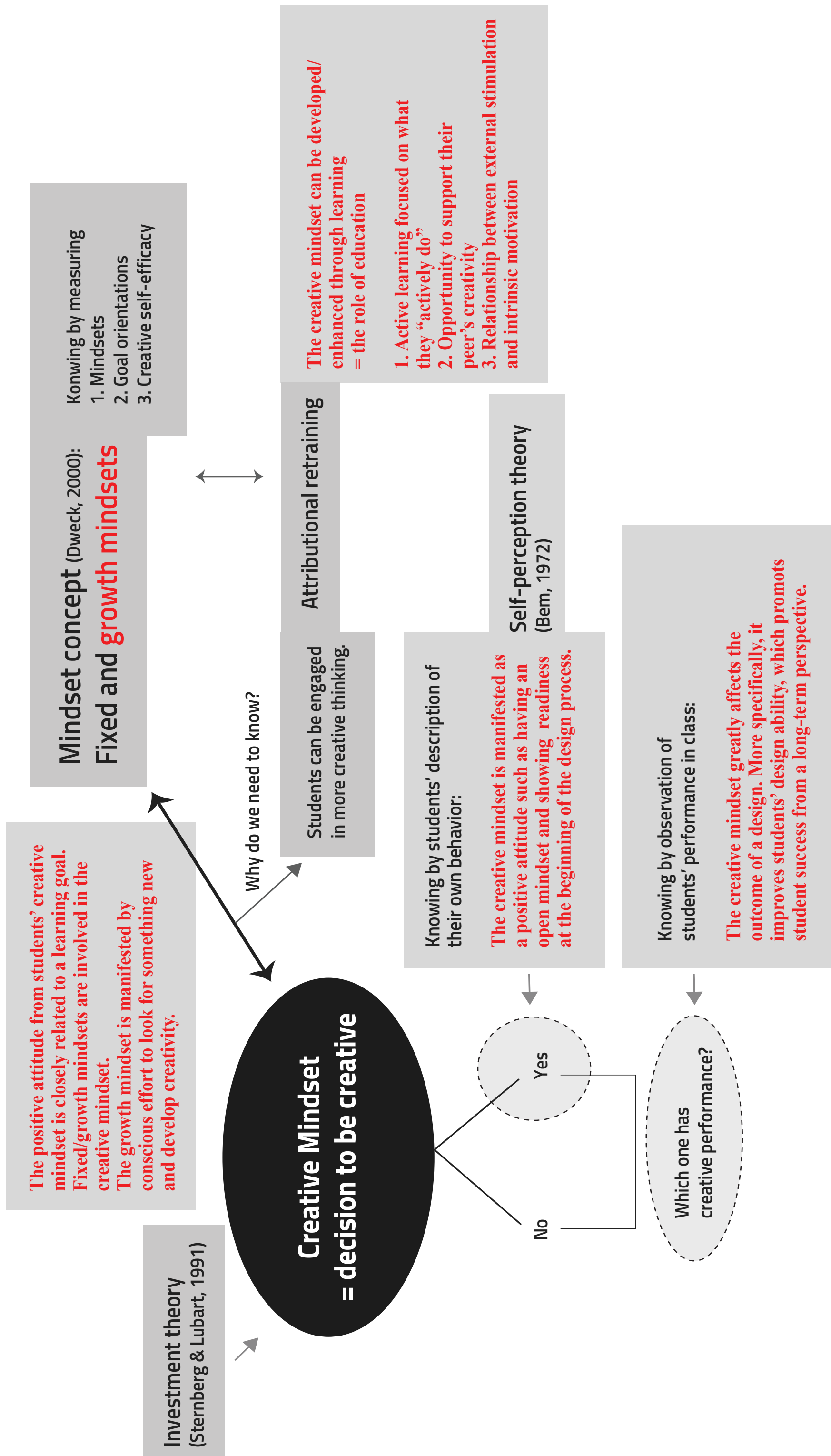

Figure 17. Revisiting Concept Map with the Findings.

References

Andrews, G., & Debus, R. (1978). Persistence and the causal perception of failure: Modifying cognitive attributions. *Journal of Educational Psychology, 70*(2), 154-166.

Amabile, T. (1983). The social psychology of creativity (Springer series in social psychology). New York: Springer-Verlag.

Amabile, T. M. (1996). *Creativity in context: Update to the social psychology of creativity.* Boulder, CO: Westview.

Amabile, T. M. (1998). How to kill creativity. *Harvard Business Review,* 76(5), 76–87.

Ames, C., & Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivation processes. *Journal of Educational Psychology*, *80*(3), 260.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York, NY: Freeman.

Beghetto, R. A. (2006). Creative self-efficacy: Correlates in middle and secondary students. *Creativity Research Journal, 18,* 447-457.

Beghetto, R. A., & Kaufman, J. C. (2007). Toward a broader conception of creativity: The case for mini-C creativity. *Psychology of Aesthetics, Creativity, and the Arts,* 73-79.

Beghetto, R. A., & Kaufman, J. C. (2009). Beyond big and little: The four c model of creativity. *Review of General Psychology*, *13*(1), 1-12.

Berelson, B. (1952). *Content analysis in communication research.* (Foundations of communication research). Glencoe, Ill.: Free Press.

Bem, D. (1972). Advances in experimental social psychology. (*Advances in Experimental Social Psychology, Volume 6*). New York: Academic Press.

Bloomberg, L. D., & Volpe, M. (2012). *Completing your qualitative dissertation: A road map from beginning to end.* Beverly Hills, CA: Sage.

Bonnardel, N., & Marmèche, E. (2005). Towards supporting evocation processes in creative design: A cognitive approach. *International Journal of Human-Computer Studies*, *63*(4), 422-435.

Brown, T., & Katz, B. (2009). *Change by design: How design thinking transforms organizations and inspires innovation* (1st ed.). New York]: Harper Business.

Burns, A. (1999). *Collaborative action research for English language teachers.* Cambridge University Press.

Chiu, C., & Hong, Y. (1995). Implicit theories and their role in judgments and reactions: A world from two perspectives. *Psychological Inquiry, 6*(4), 267-285. Retrieved from http://www.jstor.org.ezp1.lib.umn.edu/stable/1448940

Collins, M. A., & Amabile, T. M. (1999). *Motivation and creativity*. Cambridge, UK: Cambridge University Press.

Connelly, L. M. (2008). Pilot studies. *Medsurg Nursing, 17(6),* 411-2.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches.* Thousand Oaks, CA: Sage.

Cropley, D., & Cropley, A. (2010). Recognizing and fostering creativity in technological design education. *International Journal of Technology and Design Education*, *20*(3), 345-358.

Dale, E. (1969). *Audio-visual methods in teaching, 3rd edition*. Holt, Rinehart & Winston, New York.

Denzin, N. K. (1978). *The research act: A theoretical introduction to sociological methods.* New York: McGraw-Hill.

Dictionary by Merriam-Webster: America's most-trusted online dictionary. (n.d.). Retrieved from https://www.merriam-webster.com/

Dweck, C.S. (2006). *Mindsets: The new psychology of success: How we can learn to fulfill our potential.* New York: Ballantine Books.

Dweck, C.S., & Leggett, E.L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95*, 256–273.

Dweck, C., Chiu, C., & Hong, Y. (1995). Implicit theories: Elaboration and extension of the model. *Psychological Inquiry, 6*(4), 322-333. Retrieved from http://www.jstor.org.ezp1.lib.umn.edu/stable/1448951

Dweck, C.S. (1999). Self-theories: *Their role in motivation, personality, and development: Essays in social psychology.* Philadelphia: Psychology Press.

Dweck, C. S. (1986). Motivational processes affecting learning. *American Psychologist*, *41*(10), 1040.

Dweck, C. S., & Elliott, E. S. (1983). Achievement Motivation. In P. H. Mussen (Gen. Ed.), & E. M. Hetherington (Ed.), Handbook of Child Psychology (Vol. 4, pp. 643-691). New York: Willey

Ford, D. E. (1987). *Humans as self-constructing living systems.* Hillsdale, NJ: Eribaum.

Ford, C. (1996). A theory of individual creative action in multiple social domains. *The Academy of Management Review, 21*(4), 1112-1142.

Fraenkel, J. K., & Wallen, N. E. (Eds.). (2003). *How to design and evaluate research in* *education.* The McGraw-Hill Company, Inc. New York.

Frankfort-Nachmias, C., & Nachmias, D. (1996). *Research methods in the social sciences*. St. Martin's Press, Inc. New York

Guba, E. (1981). Criteria for assessing the trustworthiness of naturalistic inquiries. *Educational Technology Research and Development, 29* (2), 75-91.

Hass, R., Katz-Buonincontro, J., Reiter-Palmon, R., & Tinio, Pablo. (2016). Disentangling Creative Mindsets From Creative Self-Efficacy and Creative Identity: Do People Hold Fixed and Growth Theories of Creativity? Psychology of Aesthetics, Creativity, and the Arts, 10(4), 436-446.

Hennessey, B.A., & Amabile, T. M. (1987). *Creativity and learning.* Washington, DC: NEA Professional Library.

Hertzog, M.A. (2008). Considerations in determining sample size for pilot studies. *Research on Nursing & Health, 31,* 180-191.

Hong, Y. Y., Chiu, C. Y., Dweck, C. S., Lin, D. M. S., & Wan, W. (1999). Implicit theories, attributions, and coping: A meaning system approach. *Journal of Personality and Social Psychology*, *77*(3), 588.

Jaussi, K. S., Randel, A. E., & Dionne, S. D. (2007). I am, I think I can, and I do: The role of personal identity, self-efficacy, and cross-application of experiences in creativity at work. *Creativity Research Journal, 19,* 247-258

Karwowski, M. (2014). Creative mindsets: Measurement, correlates, consequences. *Psychology of Aesthetics, Creativity, and the Arts*, *8*(1), 62.

Kaufman, J. C., & Sternberg, R. J. (Eds.). (2010). *The Cambridge handbook of creativity*. Cambridge University Press.

Kelly-Tunis, K. (2006). Know the difference between education and training. *Pest Control*, *74*(4), 62-63.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry, Vol. 75*. Beverly Hills, CA: Sage.

Lindström, L. (2006). Creativity: What is it? Can you assess it? Can it be taught? *International Journal of Art & Design Education*, *25*(1), 53-66.

Litman, J. (2005). Curiosity and the pleasures of learning: Wanting and liking new information. *Cognition & Emotion*, *19*(6), 793-814.

Lubart, T.I. (1994). Creativity. In R.J. Sternberg (Ed.), *Thinking and problem solving* (pp. 289-332). San Diego: Academic.

Makel, M. C. (2008). *The malleability of implicit beliefs of creativity and creative production*. ProQuest.

Martindale, C. (1989). Personality, situation, and creativity. In J. A. Glover & R. R. Ronning (Eds.), *Handbook of creativity: Perspectives on individual differences* (pp. 211–232). New York: Plenum.

Mawson, B. (2003). Beyond the design process: An alternative pedagogy for technology education. *International Journal of Technology and Design Education*, *13*(2), 117-128.

Myers, D. G. (2001). *Social psychology* (Ch. 18). In D. G. Myers (Ed.), *Psychology* (6th ed.) (pp. 643-688). New York: Worth.

Meho, L. I. (2006). E-mail interviewing in qualitative research: A methodological discussion. *Journal of the Association for Information Science and Technology*, *57*(10), 1284-1295.

Mindsets evaluation (n.d.). Retrieved from http://mindsetonline.com/testyourmindset/step1.php

Newell, A. & Simon, H. A., (1962). Computer simulation of human thinking and problem solving. *Monographs of the Society for Research in Child Development*, 137-150.

O'Connor, A., J., Nemeth, C. J., & Akutsu, S. (2013). Consequences of beliefs about the malleability of creativity. *Creativity Research Journal*, *25*(2), 155-162.

Papanek, V. (1971). *Design for the real world: Human ecology and social change*. Chicago Review Press.

Plucker, J. A., Beghetto, R. A., & Dow, G. T. (2004). Why isn't creativity more important to educational psychologist? Potentials, pitfalls, and future directions in creativity research. Educational psychologist, 39(2), 83-96.

Puente-Diaz, R. (2016). The influence of creative mindsets on achievement goals, enjoyment, creative self-efficacy and performance among college students from Mexico. *International Journal Of Psychology, 51*(S1), 1065.

Richards, R. (2010). Everyday creativity. *The Cambridge handbook of creativity*, 189ff.

Roedel, T. D., Schraw, G., & Plake, B. S. (1994). Validation of a measure of learning and performance goal orientations. *Educational and Psychological Measurement*, *54*(4), 1013-1021.

Runco, M. A. (2004). Everyone has creative potential. In R.J Sternberg, E. L. Grigorenko, & J. L. Singer (Eds.), *From potential to realization* (pp. 32-30). Washington, DC: American Psychological Association.

Sawyer, R. (2012). *Explaining creativity : The science of human innovation* (2nd ed.).

New York: Oxford University Press.

Sawyer, R. (2006). Educating for Innovation, *The International Journal of Thinking Skill And Creativity*, Vol. 1, No. 1, pp. 41-48.

Schunk, D.H. (2008). *Learning theories: An educational perspective (5th ed.).* Upper Saddle River, NJ: Pearson Prentice Hall.

Simon, H. A. (1996). *The sciences of the artificial*. Boston: MIT Press.

Simon, H. A. (1995). Problem forming, problem finding and problem solving in design. *Design & Systems*, 245-257.

Smith, L.F. (2008). The art of science and the science of art. *International Journal of Creativity, and Problem Solving, 18(2),* 101-113.

Stein, M. I. (1953). Creativity and culture. *The Journal of Psychology*, 311-322.

Sternberg, R. J. (1985). Implicit theories of intelligence, creativity, and wisdom, *Journal of Personality and Social Psychology*, 607-627.

Sternberg, R. J. (1988) *The nature of creativity: Contemporary psychological perspectives.* Cambridge University Press.

Sternberg, R. J., & Lubart, T. I. (1991). An investment theory of creativity and its development. *Human Development*, *34*(1), 1-31.

Sternberg, R. J. (2006). The nature of creativity. *Creativity Research Journal*, *18*(1), 87-98.

Tierney, P., & Farmer, S. M. (2011). Creative Self-Efficacy Development and Creative Performance over Time. *Journal of Applied Psychology, 96*(2), 277-293.

Thiemann, S., & Kraemer, H. C. (1987). How many subjects?: Statistical power analysis in research.

Torrance, E. P. (1983). *Creativity in the classroom.* Washington, DC: National Education Association.

Weber R. (1990). *Basic content analysis*, A Sage University Paper.

Wong, Y. L., & Siu, K. W. M. (2012). A model of creative design process for fostering creativity of students in design education. *International Journal of Technology and Design Education*, *22*(4), 437-450.

Yin, R. (2016). *Qualitative research from start to finish* (Second ed.). New York: Guilford Press

Zhang, Y., & Wildemuth, B. M. (2009). Unstructured interviews. In B. Wildemuth (Ed.), *Applications of social research methods to questions in information and library science* (pp.222-231). Westport, CT: Libraries Unlimited.

Appendix A

Consent Form for Creative Growth/Fixed Mindset Survey

You are invited to participate in a survey on the creative mindset. This is a research project being conducted by Joungyun Choi, a doctoral student at the University of Minnesota. It should take approximately 10 minutes to complete.

PARTICIPATION

Your participation in this survey is voluntary. You may refuse to take part in the research. You are free to decline to answer any particular question you do not wish to answer for any reason.

BENEFITS

You will receive no direct benefits from participating in this research study. However, your responses may help us learn more about how design students have creative mindsets, develop them, and ultimately, how creative mindsets influence students' design processes, outcomes, and ultimately, their success in design courses.

RISKS

The possible risks or discomforts of the study are minimal. You may feel a little uncomfortable answering personal state of mind questions in the survey.

CONFIDENTIALITY

Your survey answers will be transferred to data, which will be stored in a password-protected personal PC. No one will be able to identify you or your answers, and no one will know whether or not you participated in the study other than the project investigator (researcher). No names or identifying information will be included in any publications or presentations based on these data, and your responses to this survey will remain confidential.

CONTACT

If you have questions at any time about the study or the procedures, you may contact my research supervisor, Professor Brad Hokanson, via email at brad@umn.edu

Please sign below indicating that

- You have read the above information.
- You voluntarily agree to participate.

Participant signature____Date________________

Appendix B

Questions regarding your

Creative growth mindsets, Goal orientations and Self-reported Creativity

Thank you for allowing me to communicate with you. I am seeking your input to better understand mindsets regarding creativity, goals, and motivations about your creative design process. I ask that you circle the number that best corresponds with your level of agreement.

Your name:

Your email address:

Please show your degree of agreement with each item.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

1. Everyone can create something great at some point if he or she is given appropriate conditions.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

2. You either are creative or you are not-even trying very hard you cannot change much.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

3. Anyone can develop his or her creative abilities up to a certain level.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

4. You have to be born a creator-without innate talent you can only be a scribbler.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

5. Practice makes perfect-perseverance and trying hard are the best ways to develop and expand one's capabilities.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

6. Creativity can be developed, but one either is or is not a truly creative person.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

7. Rome wasn't built in a day-each creativity requires effort and work, and these two are more important than talent.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

8. Some people are creative, others aren't-and no practice can change it.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

9. It doesn't matter what creativity level one reveals-you can always increase it.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

10. A truly creative talent is innate and constant throughout one's entire life.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

11. I enjoy challenging new design project assignments.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

12. It is important for me to get better grades than my classmates.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

13. I persevere, even when I am frustrated by a task.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

14. I work hard, even when I don't like my group.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

15. I like others to think I am creative.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

16. It bothers me the whole day when I make a big mistake.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

17. It is important to me to always be more creative than others.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

18. I prefer challenging projects, even if I don't do as well at them.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

19. I try even harder after I fail at something.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

20. I feel angry when I do not do as well as others.

1	2	3	4	5	6

Strongly Agree Agree Somewhat Agree Somewhat Disagree Disagree Strongly Disagree

21. I am good at coming up with new ideas.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

22. I have a lot of good ideas.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

23. I have a good imagination.

1	2	3	4	5	6
Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree

Appendix C

CONSENT FORM
Interviews for creative mindset research

You are invited to participate in research regarding the creative mindset in Design Education. You were selected as a possible participant because you are a student who is studying in design areas. I am seeking your input to better understand your experience, goals, and motivations to pursue a design education, and how you define a creative mindset.

Background Information
Mindset theory explains that a growth mindset creates powerful intrinsic motivations within people as antecedents to their behavior, which can be developed and taught. Carol Dweck and her colleagues have examined how these unconscious beliefs about intelligence influence motivation and performance. If this theory can be applied to the creativity realm, even though some students may exhibit lower levels of creativity or may not use it as much as others, they can actually be creative if they work toward acquiring a growth mindset involving their creativity. I thought that this should be the first priority in any creative design work. The purpose of this study is to understand how design students can have or develop creative mindsets.

Procedures
If you agree to be in this study, I will ask you to participate in a structured interview asking about your opinions and experience. I will not share confidential information about you. Rather, I want your opinions.

Risks and Benefits of Participating in the Study
The study poses minimal risks. Interview questions will ask for your opinions, along with your experiences and habits of thinking. You may refuse to answer any question that may make you uncomfortable.

Compensation
There will be a $30 Amazon gift card for participating in this interview.

Confidentiality
Interview answers and observation notes will be kept confidential. No individual will be named on the interview or observation sheets; furthermore, no reports or presentations will include any information that would identify a participant.

Research records will be kept in a secure, safe location at the University of Minnesota, and only the researcher will have access to those materials. All data and records will be securely destroyed and shredded after completion of the study.

Voluntary Nature of the Study
All participation in this study is voluntary. The decision of whether or not to participate in the study will not affect your relationship with the University of Minnesota. If you decide to participate

in the study, you are welcome to refuse any answer or withdraw your participation at any time without affecting the aforementioned relationships.

Contacts and Questions

Any questions or comments you may have about the project, interviews, observations, photographs, reports, or presentations may be directed to Joungyun Choi (choi0503@umn.edu). Any questions you may have now or later are welcome.

_____Please initial if you give permission to be recorded.

Participant signature____Date________________

Investigator signature _______________________________________Date________________

Appendix D

Interview questions

1. A description of your own design process, as well as your thought process (thinking habits), from start to finish in your design projects or art activities (if these are different in each design project or activity, how are they different?).

2. How do you think about your OWN creativity? (Are you a creative person? Why do you think that? How are you different than others in terms of creativity?)

3. A definition of creativity (from your perspective) / A description of creative mindsets for you: From your perspective, what is creative mindsets?

4. A description of the factors (e.g., yourself: things in your mind, your own activities that you usually do spontaneously…, or external stimuli: design workshops, teacher's teaching style, design studio courses, critiques…) that affect you in being more creative.

5. Why do you choose Design as your major?

Appendix E

Letter to request a visit design class

Dear Professor,

I am Joungyun Choi, who is a doctoral student at the University of Minnesota at the College of Design.

I am writing to request the opportunity to visit your class (DES XXXX) for my research "Creative mindset in design education." I will visit during your class time and give the survey questions to your students. The survey will take 15 minutes, including an introduction to the research.
The purpose of my research is to know about the relationship between creativity and students' creative mindset. I am especially interested in knowing how design students develop their mind toward creativity, develop creative mindsets, and how creative mindsets influence students' design processes, outcomes, and ultimately their success in design courses.
The study is broken into three phases: phase one is scheduled to begin in October 2017, phase two is scheduled to begin in November and phase three is schedules to begin at the same time of the phase one.

> <u>Phase one</u> will take 15 minutes of your class time. The time will be used to introduce the research to the students and administer the test regarding "Mindsets," "Goal Orientations," and "Self-Reported Creativity." The actual test will take less than 10 minutes. A pencil to paper activity is gauged to measure students' creative mindsets. Based on the first phase of the study, some of the participants will be invited to continue to phase two.
>
> <u>Phase two</u> will be one hour of a direct interview. Students will be contacted individually at this time. I'm interested in learning about students' opinions and experiences of their design process.
>
> <u>Phase three</u> with be class observation to observe participants. I visited two class t imes a week and sit or participate your class while I am observing theparticipants.

If you allow me to visit your class for my research, please let me know when is good for you.

Thank you.